FLIGHT
The AIRCRAFT ENGINEER & AIRSHIPS

First Aero Weekly in the World
Founder and Editor: STANLEY SPOONER
A Journal devoted to the Interests, Practice, and Progress of Aerial Locomotion and Transport
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DIARY OF FORTHCOMING EVENTS

Club Secretaries and others desirous of announcing the dates of important fixtures are invited to send particulars for inclusion in the following list:

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Nov. 15–26 International Air Navigation Congress (Paris)
Nov. 17 .... Lecture, "Requirements and Difficulties of Air Transport," by Col. F. Searle, before R.Ae.S.
Dec. 1 .... Lecture, "The Present State of Airship Development," by Major G. H. Scott, C.B.E., A.F.C., before R.Ae.S.
Dec. 15 .... Lecture, "Development of the Fighting Aeroplane," by Capt. F. M. Green, before R.Ae.S.

1922.

Jan. 5 .... Lecture, "Specialised Aircraft," by Wing-Com. W. D. Beatty, before R.Ae.S.
Jan. 19 .... Lecture, "Aeroplane Installation," by Brig.-Gen. R. K. Bagnall-Wild, before R.Ae.S.
Feb. 2 .... Lecture, "Radiological Research," by Dr. V. E. Pullin, before R.Ae.S.
Feb. 16 .... Lecture, "Methods of Instruction in Aeroplane Flying," by Sq.-Leader Portal, before R.Ae.S.
Mar. 2. .... Lecture, "Testing Aircraft to Destruction," by W. D. Douglas, before R.Ae.S.
Mar. 30 .... Lecture, "The Design of a Commercial Aeroplane," by Capt. de Havilland, before R.Ae.S.

EDITORIAL COMMENT

WHILE the Paris Aero Show was replete with technical interest, there is another aspect of it which appeals to us much more than any indications of constructional progress observable. That is the fact, which was quite outstanding, that the exhibition was really a wonderful example of fine propaganda work on behalf of the movement of aviation, more especially of the civil side. While it was organised by the French industry, the fact obtruded at every turn that the State was whole-heartedly in co-operation with the actual promoters in the effort to secure for French aviation the recognition which admittedly it has earned at the hands of the whole aeronautical world. The atmosphere was one of encouragement and of a desire on the part of the State and the industry alike to foster the development of aviation as such. We do not refer by any means to schemes of subsidy or that concrete encouragement which is spelled in terms of pounds, shillings and pence. Rather, as we have put it, was it a case of atmosphere. One did not feel that here was an exhibition which had the merely tentative approval of the State—that sort of patronising attitude with which we in this country are familiar when the Government is graciously pleased to signify that a particular movement is an approved one. The feeling one had is difficult to define, and we shall not attempt to elaborate it. But there *was* a difference, and a very marked one, between the Paris Show and the attitude towards aviation disclosed by the French Government and that which obtains when our own industy organises such an exhibition as that which has taken place in Paris.

The Paris Aero Show

It was quite typical of the difference of attitude adopted by the respective Governments of the two countries. On the one hand, as we all know, that of the British Government is almost entirely negative. It is the policy, we are told, to allow commercial enterprises to work out their own salvation, sometimes with the blessing of the Government, more often without. In France, on the other hand, it seems that the first consideration is whether or not the enterprise concerned is one that is really for the national good. If it is, then the State comes forward

with direct encouragement, which is continued until it becomes unnecessary. It is the difference between the two policies which accounts for the flourishing state in which French aviation finds itself today, while our own industry is hard put to it to keep its head above water.

* * *

The Disarmament Proposals

The proposals made by the United States Government for a naval holiday have, quite naturally, been generally welcomed by a world which is war-weary and staggering under the burdens left by the War and of the weight of the armaments which must be maintained until such times as a common agreement for their limitation can be reached. Whether these well-meant proposals will be adopted in their entirety remains to be seen, but that something very substantial will result is not for a moment in doubt.

It is interesting to note that under para. 27 of the Memorandum setting forth the proposals, it is stated that " Limitation of naval aircraft is not proposed." At the same time, it should be pointed out that an automatic limitation is placed on the construction of such craft by limiting the number of aeroplane carrying ships which each Power subscribing to the Convention which will ultimately result is to be allowed to possess. A note added to the paragraph in question sets forth that owing to the fact that naval aircraft can be readily adapted from special types of commercial aircraft, it is not considered practicable to prescribe limits for such craft.

While we are as much in favour of the limitation of armaments as any, we cannot but express satisfaction regarding the attitude which is adopted towards naval aircraft, because we agree with the basic contention of the added note, that it is not practicable in the circumstances to set a limit on the numbers of naval aircraft which shall be owned by the various naval Powers. For this reason : that one of the most valuable commercial types of the future will undoubtedly be the amphibian machine in some state of development, and if it were decided to limit naval aircraft in numbers we cannot see how it could be done without placing a serious obstacle in the way of the development of commercial types, which is the last thing in the world we desire to see. It is perfectly obvious that such a limitation would open the door to endless discussion as to what the definition of a naval aircraft should be. We should undoubtedly arrive at a stage similar to that which would ensue if it were decided to limit the number of merchant ships convertible into fleet auxiliaries in case of war. Neither is within the bounds of practical politics, nor do we think either is at all necessary. Therefore, we are quite satisfied with the proposal at it stands.

* * *

The Future of the Air Ministry

All sorts of rumours appear to be rife as to the future of the Air Ministry. It has been said that the Geddes Economy Committee is to recommend the abolition of the Ministry as a separate Department of State, but it has been explained that, in common with all other Departments, the Air Ministry was asked to answer a number of questions relating to details of its work and the expenditure involved, and also to justify both policy and the costs involved in carrying out that policy. It is stated by one morning newspaper that " As far as can be ascertained " there is no definite suggestion at all on the lines that the Admiralty and the War Office shall again take charge of their own flying services. To emphasise this, the Prime Minister stated recently that the Government had not decided to do away with the Air Ministry as a separate Department. It may be observed that he did not say the Government had taken a definite decision *not* to scrap the Ministry.

As we are not in the inner councils of the Government we cannot profess to know what is in their minds, but this we do know : that the constantly recurring rumours of the kind under discussion are doing no good at all either to the Royal Air Force or to the civil side of the Air Ministry's work. To enter upon a long discussion of the matter in its present stage would be quite unprofitable, so we shall leave it for the time being with the remark that the sooner the Government again announces in the most unambiguous terms that the Air Ministry is now as much a part of the machinery of the State as, let us say, the Home Office, and that it is here to stay, the better will it be for all concerned.

* * *

Mr. Holt Thomas and the Subsidy

Writing to *The Times* recently, Mr. Holt Thomas puts forward some rather interesting suggestions as to the manner in which the money set aside for subsidising the cross-Channel services should be allocated. He does not consider the present system at all satisfactory, since in his view it puts a premium on the use of inefficient machines. The cost of running an efficient modern aeroplane, he says, carrying one ton, should not exceed 2*s*. 6*d*. per mile. We have £200,000 allotted by the Treasury to the cross-Channel services, but he suggests that half this amount is ample, and should be used for the next twelve months in definitely paying the companies operating the lines conditionally on the machines used, and the running of these lines, being satisfactory to the Air Ministry. Three machines, he points out, running to Paris, one to Brussels, and one to Amsterdam, each way, daily, roughly means a distance of 2,500 miles a day. If, following the lines of the French Government, the companies were paid half a crown a mile, letting them take all the traffic receipts as profit, it would cost only £93,000 per annum for 300 days a year, and the following years we could adopt the suggestion of making payments on a sliding scale, but we should have definitely satisfactory results from the Government subsidy which, in his opinion, have certainly not been arrived at during the present year. Under the proposed system, absolutely efficient British air lines would be running next year. Let us, he says, pay the approved lines reasonably for the services they are going to render, on condition that those services are run to the satisfaction of the Air Ministry. In paying on receipts to several companies the Government is really creating difficulties rather than doing away with them.

These views are very interesting, and, on the face of them, seem to be quite practical, and it would be interesting to have the views of others concerned. Obviously, if the Government can at once save more than half the subsidy, to be devoted to the encouragement of other lines, and secure greater efficiency at the same time, these ideas and suggestions ought to receive the closest attention.

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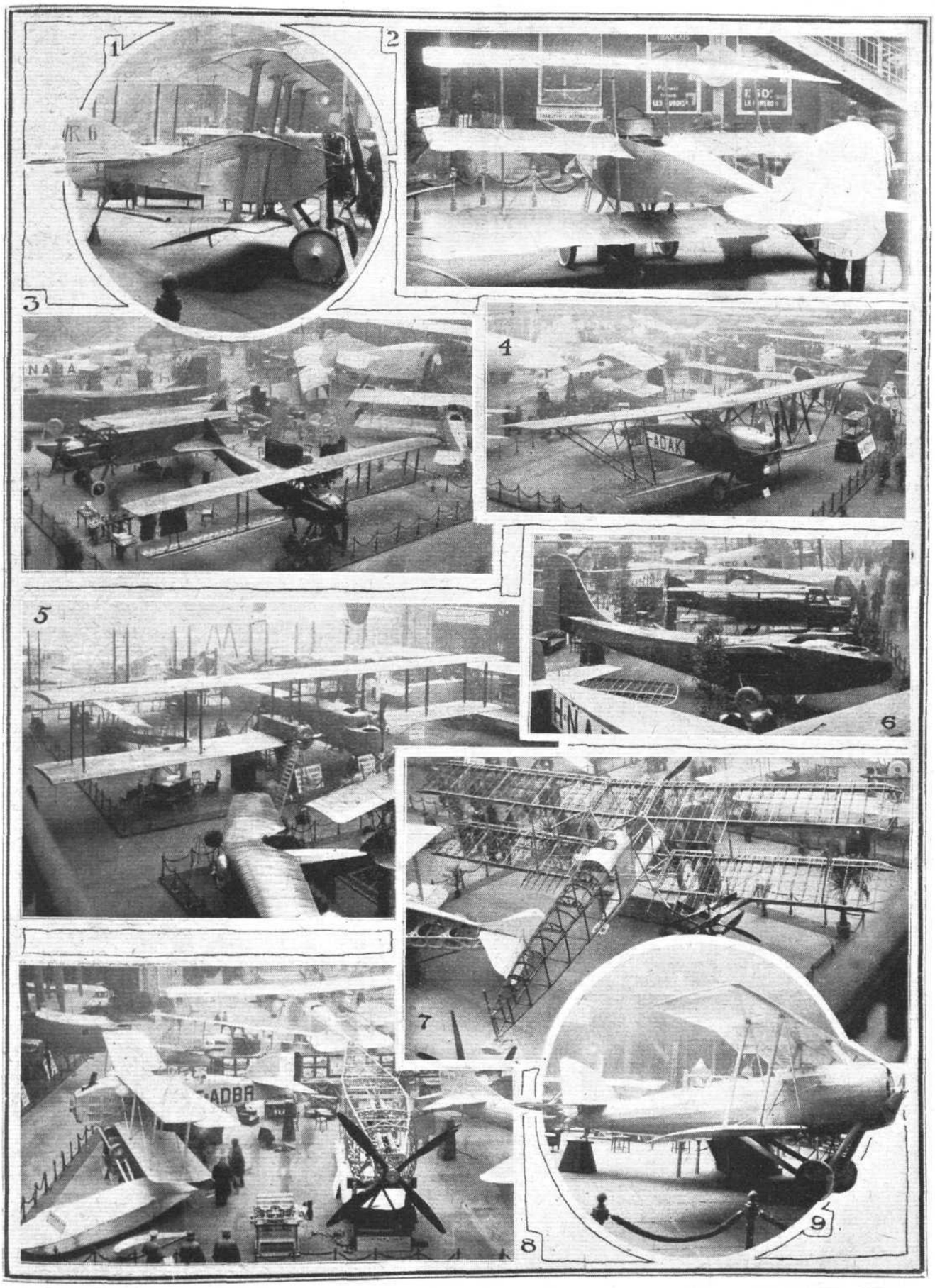


THE PARIS SALON: Some of the machines. 1 and 2, the small Ricci Triplanes. 3, Réné Tampier. 4, Nieuport Astra. 5, Farman Goliath. 6, F.B.A. (flying boat hulls). 7, Pierre Levasseur. 8, Breguet Leviathan. 9, S.E.C.M.

MODERN BRITISH ENGINES

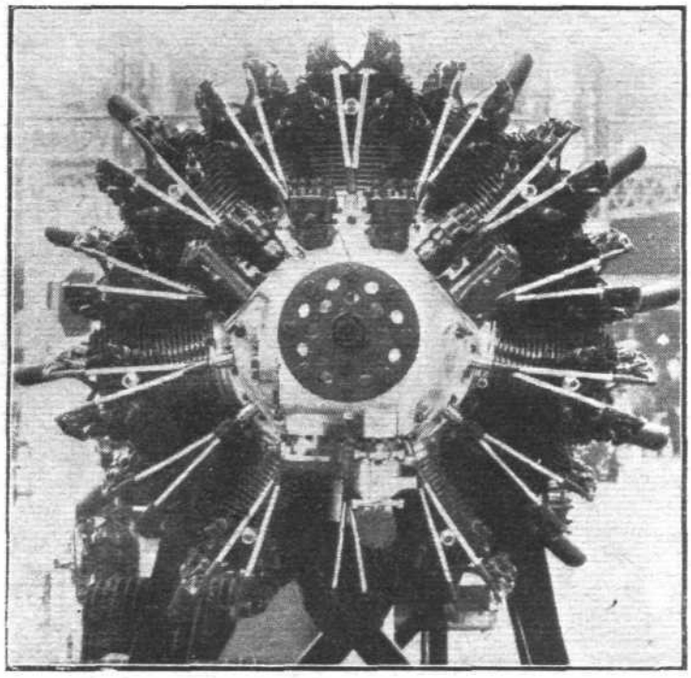
A *Résumé* of Aero Engines of Today

ARMSTRONG-SIDDELEY MOTOR-CAR CO., LTD., COVENTRY

THIS firm, which is allied with the Sir W. G. Armstrong, Whitworth and Co., Ltd., is producing two very successful aero engines, both radial air-cooled, and known as the "Lynx" and the "Jaguar."

The "Lynx" is a seven-cylinder engine developing a normal h.p. of 165 at 1,650 r.p.m. (maximum h.p., 175 at 1,750 r.p.m.). The bore and stroke are 5 ins. and 5½ ins. respectively, and the petrol consumption 0.55 pt./h.p./hr. and oil consumption 0.03 pt./h.p./hr.

The cylinders have steel barrels screwed into hemispherical aluminium heads. The latter are thoroughly annealed in order to prevent growth and distortion. The pistons are of aluminium alloy and are fitted with three compression rings



The 14-cyl. 320 h.p. Armstrong-Siddeley "Jaguar."

and one scraper ring. The gudgeon pin is of ample size and floats both in the piston and in the connecting rod.

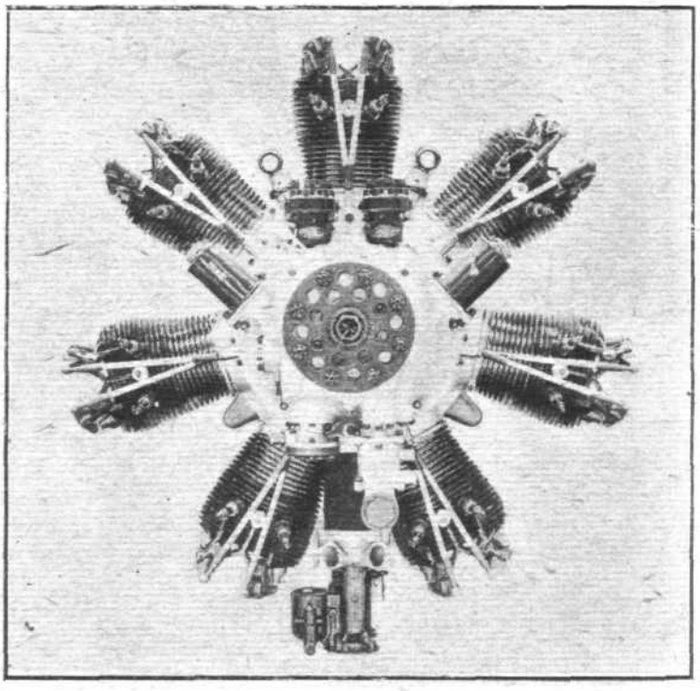
A somewhat unique connecting-rod system is employed. The master rod proper is separate from the split big-end, which is designed so that all the rods can easily be dismantled. The wrist pins are floating. The crankshaft is in one piece of exceptional stiffness, and is supported by roller bearings throughout. The propeller thrust is taken by a single thrust race, so mounted that it absorbs thrust in either direction. The patented system of double oil circulation cools the crankshaft and big-end.

Lubrication is on the dry sump principle. Any excess of oil is collected in an extension at the bottom of the crank-case and pumped back to the tank through a filter. The pressure pump delivers oil to the hollow crankshaft, which is drilled with a double system of holes, out and return, so that the oil circulates from the front to the extreme back and to the front again, where it is freely delivered to the timing gear. This system not only keeps the crankshaft and big-ends cool, but makes the lubrication of the crank-pins absolutely sure, as the oil is supplied to them from both the out and return lines. A second filter is inserted between the pressure pump and the crankshaft. Both oil pumps and filter are mounted in front of the engine.

Dual ignition is fitted, by battery and coil or by magneto.

An epicyclic-type timing gear is fitted, the cams rotating at one-sixth crankshaft speed. It is mounted entirely on ball and roller bearings. There are two independent cams, for inlet and exhaust. The overhead valves are operated by push rods in front of the engine and rockers.

The induction system is composed of pipes radiating from a central chamber containing a fan mounted on the back of the crankshaft. This not only increases slightly the volumetric efficiency, but thoroughly mixes the incoming gases and makes for almost perfect uniformity of distribution. The mixture is heated by the exhaust gases in a special muff. The carburettor and the inlet and outlet of the heating gases may be carried outside the cowling surrounding the engine. The heating muff contains no welded or packed joints, being made from castings and solid drawn tube.



The 7-cyl. 165 h.p. Armstrong-Siddeley "Lynx."

Accessibility has received special attention, the cylinders can readily be removed and it is easy to get at the oil accessories.

The "Jaguar" has 14 cylinders, arranged radially in two rows of seven. A normal h.p. of 330 is developed at 1,650 r.p.m., and a maximum of 355 at 1,750 r.p.m. The bore and stroke are the same as in the "Lynx," as are the petrol and oil consumption. The weight, dry, is 720 lbs., and the weight per b.h.p. is 2.17. The over-all length of the "Jaguar" is 43 ins., whilst the over-all diameter and the diameter which may be covered by cowling are 46 ins. and 29 ins. respectively.

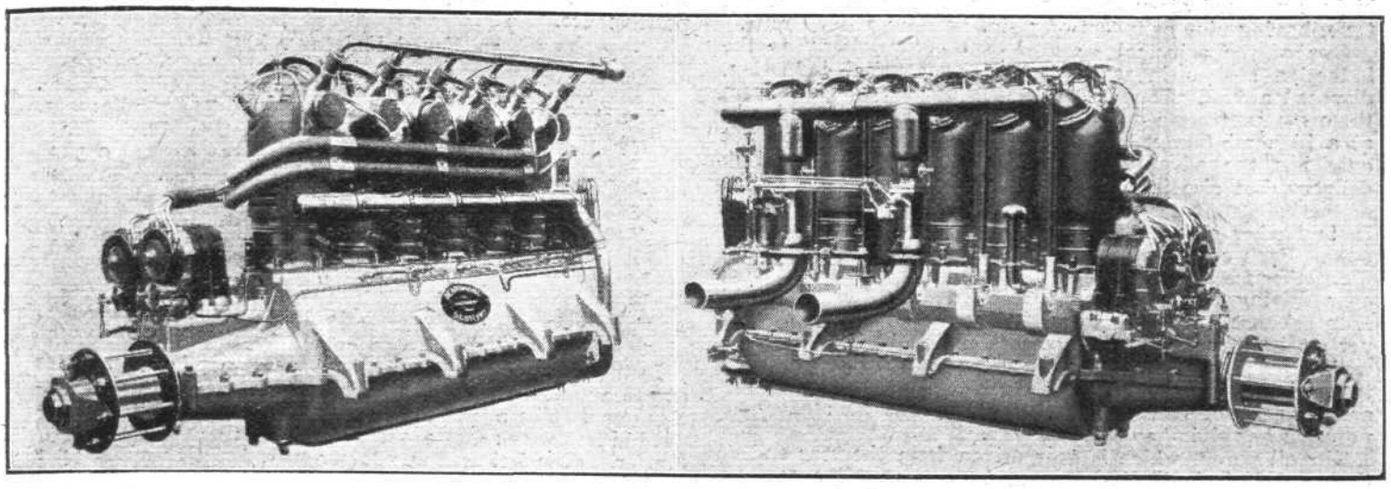
As regards most of the other details of this engine, the same remarks on the "Lynx" more or less apply to the "Jaguar," allowing for differences due to the larger engine.

THE BEARDMORE AERO ENGINE, LTD.,

112, Great Portland Street, London, W.1

THIS company is one of the many branches of that world-famous engineering concern, Messrs. William, Beardmore and Co. They are not, at the moment, constructing any new types of aero engines, but are devoting their attention to the supply of the well-known 160 h.p. Beardmore aero engine, of which they have a large number—and a like quantity of spares—in stock, ready for immediate delivery. The reliability of this engine is indicated by the fact that during the four-and-a-half years of War some three thousand Beardmore aero engines were produced and supplied to the British Government. In design the Beardmore is clean and simple, and the materials used throughout are of the finest and most suitable obtainable. The engine is manufactured in a special factory exclusively devoted to this work, equipped with modern machinery and the requisite scientific apparatus of all descriptions.

It is of the six-cylinder vertical water-cooled type, having a bore and stroke of 142 mm. and 175 mm. respectively.



Two views of the 160 h.p. (6-cyl. vertical) Beardmore aero engine.

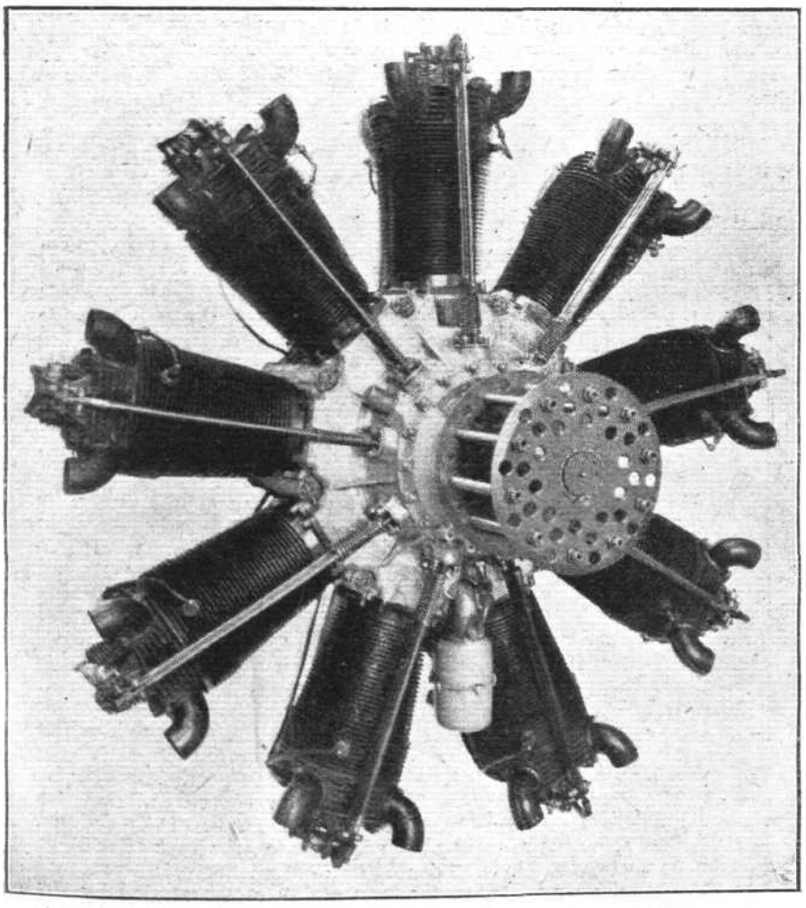
The cylinders are machined from a special grade of cast-iron combined with a screwed flanged-steel sleeve at the base. They are separate and are fitted with copper water-jackets. The valves are in the cylinder-heads, and are operated from a camshaft, situated alongside the crankshaft, by push rods and overhead rockers. Special laminated springs are used for the valves, and adjustable rocker points and push rods are provided.

Two synchronised carburettors, of a special automatic, type having no moving parts, are fitted. They are fireproof and are hot water-jacketed. A special control for altitude work is also fitted. Ignition is by two independent high-tension magnetos, and two plugs per cylinder. The lubrication is by pressure feed, with valveless piston pumps. A sight gauge is fitted to the oil reservoir. The normal r.p.m. are 1,200, and the oil and petrol consumption are 0.028 and 0.6 pt./h.p./hr. respectively.

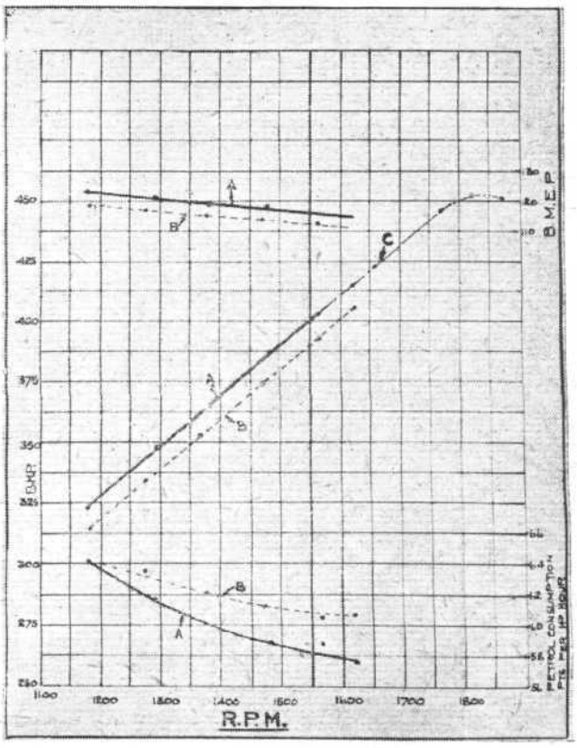
As regards the constructional features, these may be summarised as follows: The pistons are machined from steel forgings combining extreme lightness with great strength. The crankshaft is supported on seven white-metal bearings in steel shells. The design of the crank-case permits of the lower portion being removed for the inspection and adjustment of the bearings without disturbing the crankshaft. A fine adjustment for the valve timing is provided by a vernier on the camshaft gear wheel. Double-thrust ball races are fitted so that the engine is suitable for either tractor or pusher airscrew.

THE BRISTOL AEROPLANE CO.

Filton, Bristol.



BESIDES the construction and design of aircraft, the Bristol Aeroplane Co. also produce aero engines—in which capacity they have already achieved the success that has always gone with the name of "Bristol." The Bristol "Jupiter" aero engine—which is exhibited at the present Paris Salon—is, we believe, the



THE BRISTOL "JUPITER" 400 h.p. 9-CYLINDER RADIAL AIR-COOLED ENGINE: On the right, the power curves of the Bristol "Jupiter" for the Air Ministry Type Test. Curves "A" indicate readings taken at beginning of run; "B" indicate readings taken at end of run; and "C" indicate power obtained after Type Test.

highest powered air-cooled engine made. It is of the radial type, having nine cylinders of 5¾-in. bore by 7½-in. stroke.

One of the principal features of the "Jupiter" is the induction system in which a three-way spiral induction, disposed around the rear end of the crankcase, feeds from three carburettors a group of three cylinders independently at a high mixture velocity. This system of induction not only has the advantage of giving an improved mixture delivery, but also it makes for greater reliability by virtue of the independent feeding of the cylinders in groups, whilst it is further claimed that the starting-up is exceptionally easy. Each cylinder has two inlet and two exhaust valves.

Another feature consists of an ingenious epicyclic reducing gear driving the cam-drum (which carries four inlet and four exhaust cams) at one-eighth crankshaft speed. The perfect balance of the "Jupiter" engine is another noteworthy point, a system of sliding bob-weights being employed to ease the inertia strain of the master rod big-end—an arrangement of considerable ingenuity, but lack of space prevents our giving any details here.

The oil pump, which is gear driven from the rear end of the crankshaft, is duplicated so as to scavenge all excess oil as it settles in the crankcase, and forces oil through the crankshaft to the bearings and big-ends, excess oil thrown off lubricating the cylinder walls.

Two nine-point magnetos are diagonally driven from gearing above the oil pump gear, and between the magnetos is an electric starter. We believe the Bristol Co. have been experimenting with a small auxiliary engine for starting, and have succeeded in producing a remarkably efficient little engine, which is exhibited with the "Jupiter" at the Salon, and is illustrated on p. 759.

There are two models of the "Jupiter," one with a direct drive and the other with an epicyclic reduction gear giving an airscrew speed of 1,200 r.p.m. The horse-power developed is 450 at 1,850 r.p.m., and the weight per horse-power comes out at about 1·6-1·7 lb. The "Jupiter" is easily and rapidly dismantled, and it is claimed to have 25 per cent. less parts than any other engine of equal power.

The "Jupiter" has just recently passed the Air Ministry Type Test with very satisfactory results. It is of interest to note that only two other makes of engine, both water-cooled, have previously satisfied the rigid conditions laid down for this test, and taking into consideration the fact that the "Jupiter" is an air-cooled engine and is lighter per horse-power than either of the other two engines previously referred to, the results achieved by the "Jupiter" are certainly remarkable. We give herewith some of the results obtained from the test in question, together with the power curves, which will, we think, give a good idea of this engine's performance.

50 Hours' Endurance Test

Non-stop Runs.			Load.	B.H.P.	Cons. Oil. Pts./h.p.	Cons. Petrol. Pts./h.p.
Hrs.	Mins.	R.P.M.	Lbs.	Corrd.	Hr.	Hr
1	45	1,575	262·7	347·5	0·054	0·589
9	20	1,577	262·5	347·5	0·047	0·600
3	—	1,578	262·5	347·0	0·046	0·598
5	40	1,575	262·8	348·0	0·048	0·598
8	15	1,575	262·4	347·0	0·050	0·603
10	—	1,575	Propeller		—	—
10	—	1,575	Do.		—	—
—	—	1,576	262·75	349·5	0·048	0·589
—	—	1,577	289·2	384·5	0·051	0·595

In the slow running test the engine was run for 30 minutes at 393 r.p.m., the running being very steady and the acceleration good. The average oil and petrol consumption throughout the test were: Oil, 0·049 pt./h.p./hr.: petrol, 0·594 pt./h.p./hr. (The fuel used was 80 per cent. Aviation with 20 per cent. benzole.)

Power and full throttle tests of one hour at 1,775 r.p.m. and at 1,840 r.p.m. were carried out at the conclusion of the test, without any further adjustments and replacements being made to the engine. A cam sleeve giving slightly altered timing to accommodate higher engine revs. was substituted.

One Hour Full Throttle Test

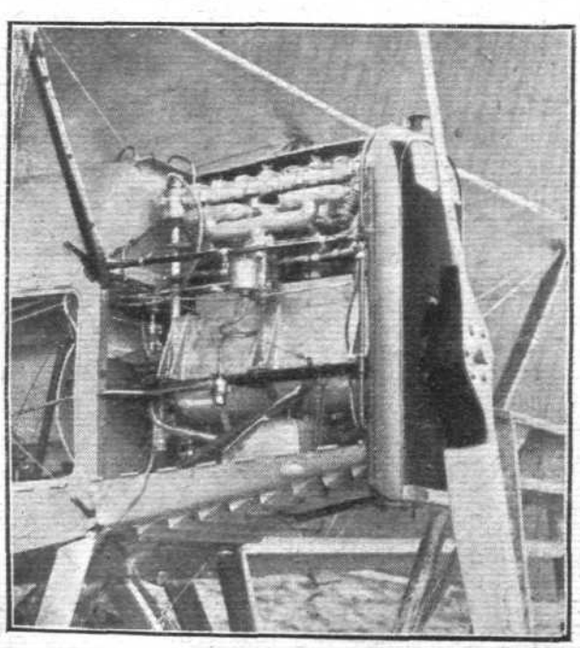
R.P.M.	1,775	1,840
Average b.h.p.	442	450
Average m.e.p. (lbs./sq. in.)	113	110
Oil consumption (pts./h.p./hr.) ..	0·0755	0·11
Petrol ,, ,, ..	0·588	0·586

A one-hour test with three cylinders cut out was also made, when the engine was set to run at 90 per cent. of normal full power (345 h.p. at 1,575 r.p.m.). There was a certain amount of vibration, but this was not excessive, and at the end of one hour petrol was turned on to the three cylinders and the engine picked up to full load at once. There was no oiling up of the plugs. The results obtained on six cylinders were as follows: b.h.p., 193; r.p.m., 1,250; oil consumption, 0·0413 pt./h.p./hr.; petrol, 0·685 pt./h.p./hr.

At the conclusion of the tests the engine was dismantled for examination, and very little signs of wear were visible, and the general condition of the engine was found to be good.

THE GREEN ENGINE CO.,

166, Piccadilly, London, W. 1.



The 35-40 h.p. Green engine, installed in an Avro "Baby" biplane.

ONE of the pioneers in Aero engine construction, the Green Engine Co., achieved fame from the first—as far back as 1909—and from then onwards, year by year, secured records and trophies in various competitions. Of considerable merit as the early Green records were, we cannot help thinking that those obtained during the last two years by the little 35–40 h.p. engine are the more remarkable—and perhaps, of greater value, for whereas the tendency in the past was to increase the horse-power of our aeroplanes, the improved efficiency of the present-day aeroplane offers the possibility of flying with smaller and still smaller horse-powers. This is indicated by the recent splendid performances put up by the Avro "Babies" fitted with 35 h.p. Green engines—first in the 1919 Aerial Derby Handicap, first and second in the 1920 Aerial Derby Handicap, non-stop flight between London and Turin during the flight to Rome and back last year, and the non-stop flight of 800 miles in nine hours from Sydney to Bandaberg this year.

Noteworthy points about the 35–40 h.p. Green engine are that it forms an exceedingly neat and compact unit, and that it is capable of taking its own air-screw thrust on ball-bearings of ample dimensions, fitted in the end of the crankcase. It is a four-cylinder vertical water-cooled, having a bore and stroke of 106 mm. and 120 mm. respectively. The nominal power is developed at 1,250 r.p.m., and the maximum power is reached at 1,350 r.p.m. It is claimed that these engines will run at full throttle for hour after hour, but, of course, it is advisable to have a reserve in hand, and a good average speed for long flights recommended by the makers is 1,050 to 1,100 r.p.m. One very important feature of this engine, especially when installed in the small, owner-pilot aeroplane, is its ability of running at very slow speeds.

It will throttle down so that it " ticks " over at a few hundred r.p.m., for quite long periods. The machine can thus be left standing unattended, like a motor-car, should the pilot wish to do so for any purpose.

The cylinders are turned from solid steel with the valve chambers rising vertically side by side from the head. They are machined both inside and out, to ensure a uniform thickness of metal, which permits the even expansion of the material and obtains the greatest cooling effect. The water jackets are spun copper with metal-to-metal joints at all parts, and the bottom of the jacket is sealed with a patent rubber-expanding joint. The arrangement of the water jackets has always been a feature of the Green engines—in fact, it is of interest to note that the general design of the 35-40 h.p. engine of today differs but slightly from the early models.

The crankcase is an aluminium casting of clean design and exceptional strength, with five bearings for supporting the crankshaft. A special feature of the design well worth noting is the entire absence of copper piping for the oil supply, the main supply pipe being integral with the casting. The main bearing bolts pass through the webs, and the top forms the holding-down studs for the cylinders. By this means the strains are absorbed by the bolts, and not the crankcase generally. These bearing bolts are turned to the depth of the thread so that the space between the stud and casting forms the duct for the oil supply to the bearings.

The crankshaft is manufactured from high tensile steel, with five main bearings of ample proportions. It is hollow, for the forced lubrication system. An overhead camshaft is fitted, with the cams cut solid on the shaft: it is supported by five bearings.

Aluminium castings of special design are employed for the pistons, each being fitted with three rings of close-grained cast iron. The connecting rods are H-section steel stampings machined all over, white metalled at the big ends, and the gudgeons being fixed rigidly in the top-end working in phosphor-bronze bushes in the pistons.

The valve operating gear is mounted on the cylinder heads in such a manner as to allow the valves being readily removed. The cam cases containing the rocker arms are carried by the cam case brackets, and the shaft is supported in the cases to one side of the valves, operating them by means of the rocker arms. Nickel steel is used for the inlet valves, and tungsten steel for the exhaust valves. Both inlet and exhaust valves are carried in cast-iron cages in order to facilitate their ready removal from the cylinder head. These cages are held in position by aluminium bonnet nuts, and the arms of the cam cases bear upon these, permitting the rocker arms to actuate the valves by means of adjustable hardened steel tappet pins. By the slackening of three nuts the case hinges back on the camshaft, freeing the valves for removal.

A vertical shaft situated at the front of the crankshaft, and driven from the latter by skew-gearing, transmits the drive to the camshaft through bevel gears. An extension of the lower end of the vertical shaft drives the oil delivery pump, which is fixed on the outside of the sump, and is of the conventional gear type. This pump delivers oil to all the main bearings under considerable pressure, the overflow being collected by the undershield, whence it is drained back to the tank. The water circulation for the cooling is maintained by means of a gear pump direct coupled to the skew-gears, which latter also drive the high-tension magneto.

The complete weight of the 35-40 h.p. Green engine, with propeller boss, is 185 lbs., and the petrol and oil consumption ·58 and ·10 pint per b.h.p. hour respectively.

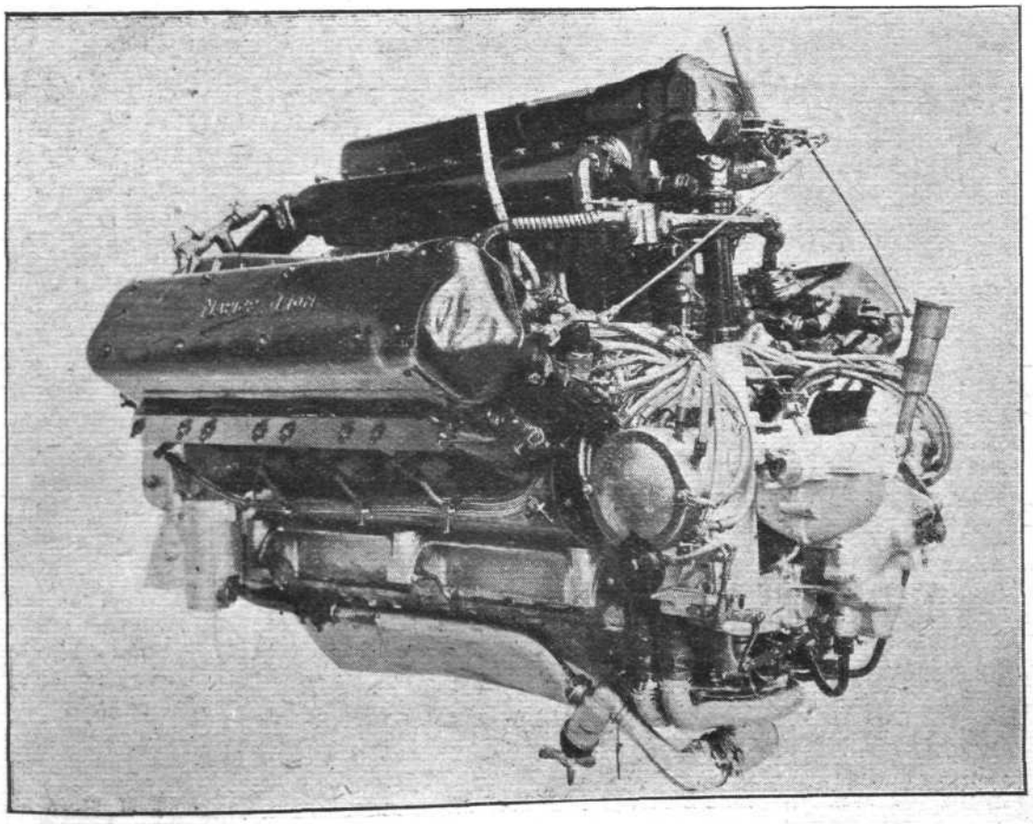
NAPIER AND SON, LTD.,

14, New Burlington Street, London, W.1.

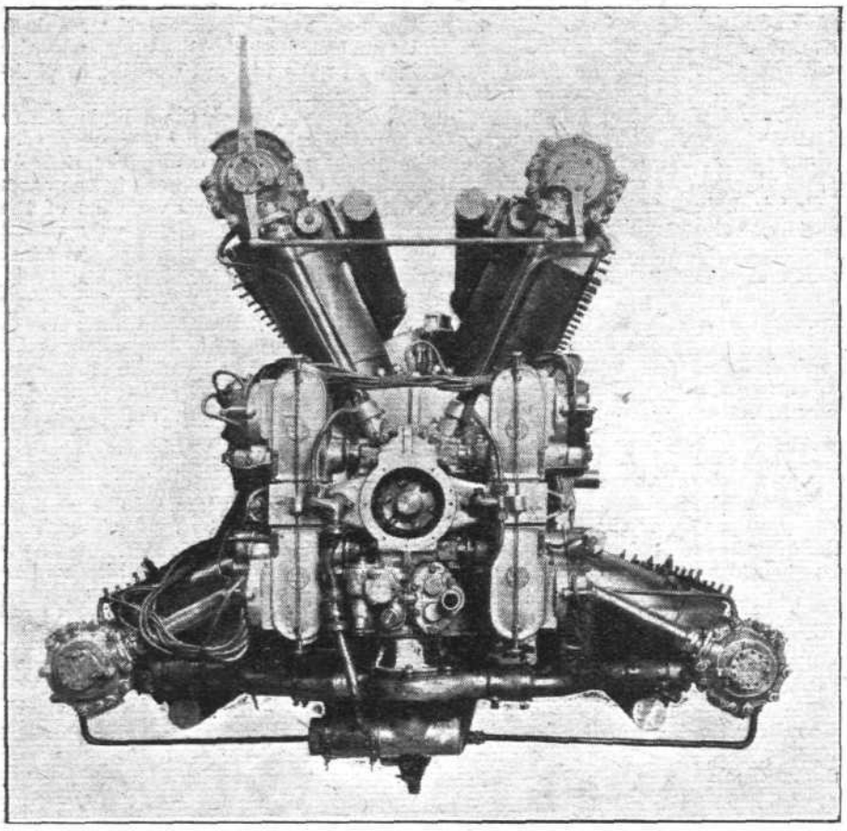
SINCE it first came into being during the latter days of the War, the Napier " Lion " aero engine has gained a world-wide reputation—from the Military as well as the Commercial and Sporting viewpoints—that is both gratifying and remarkable. To date it holds twenty-four British Air Records—a " Lion's " share, indeed!—whilst its reliability, speed, and economy were further proved by the Government trials of last year, when the highest prizes in each of the three classes were awarded to Napier-engined machines.

There are two types of Napier aero engines—one, the 450 h.p. " Lion," is so well known that only a *résumé* of its principal characteristics is necessary here: the other, the 1,000 h.p. " Cub," can only be referred to but briefly, as we are not permitted by the Air Ministry to give full details.

The 450 h.p. Napier " Lion " engine recently achieved a splendid performance in the Government Type Test which it successfully passed. This consisted of a bench test of 55 hours' duration conducting various officially observed performances. For an hour on this test the engine developed the remarkable b.h.p. of 531. Although this engine is capable of such a high b.h.p. it is interesting to mention that the Napier engines used on the London-Paris air route



The Napier " Lion " 450 h.p. 12-cyl. water-cooled engine: The cylinders are arranged in three banks of four, " broad-arrow " fashion.



A rear view of the 1,000 h.p. Napier "Cub," showing the arrangement of the 16 cylinders.

are run at half-throttle, giving a b.h.p. of approximately 325. Pilots, therefore, have a great reserve of power for any eventuality which might occur.

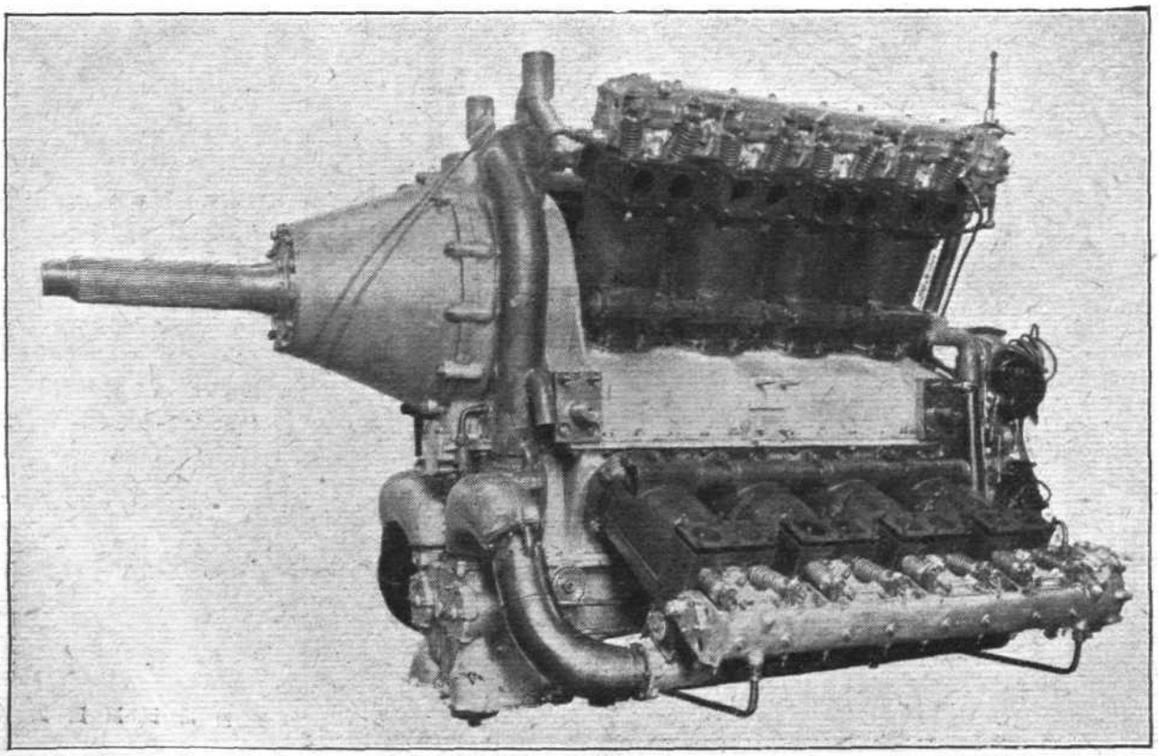
One of the principal features of the "Lion" is the arrangement of its twelve cylinders. These are placed in three banks of four, the central bank vertical and the outer banks at 60° to it. In this way a particularly short and stiff crankshaft is employed and a good balance and smoothness of running is obtained, thus adding to the reliability of the engine and reducing wear and tear. This "broad arrow" arrangement also makes for an exceedingly compact and neat engine, the over-all length being only 4 ft. 9 ins., the height 3 ft. and the width 3 ft. 6 ins.

In the high compression model (5·8 to 1), the normal horse-power is 450, at 2,000 r.p.m., and in the low compression model (5 to 1) it is 425 at the same r.p.m. The air screw is driven by spur reduction gear at 1,320 r.p.m. The weight of the engine dry, complete with airscrew-boss, carburettors, induction pipes, and hand-starting gear, is approximately 900 lbs., giving a weight per h.p. of about 2 lbs. The petrol consumption at full load comes out at ·48 lb. per b.h.p. hour and the oil consumption ·028 lb.

The cylinders, which have a bore and a stroke of $5\frac{1}{2}$ ins. and $5\frac{1}{8}$ ins. respectively, are single units, with sheet steel applied water jackets. The cylinders are remarkable in that they are not of the usual barrel form with open top and cylinder heads, but have closed tops or crowns which have four holes machined in them for receiving the valve seatings. The crowns of the cylinders are machined flat on the outside to receive a monobloc aluminium casting, which unites all four cylinders, and is, practically speaking, a common water-cooled cylinder head carrying inlet and exhaust manifolds and valve gear. The inlet manifold, it should be noted, is in the form of a simple trough-shaped tapered aluminium casting, bolted up to the common induction passage for all four cylinders in the head block. A duplex (N.S. 2) Claudel-Hobson carburettor supplies the vertical bank and the right-hand bank, the left-hand bank being supplied by a single (N.S. 1) carburettor of the same make.

The overhead camshafts are driven by vertical shafts through bevel gearing from the crankshaft. The main driving bevel on the crankshaft engages direct with the vertical shaft bevels of the right and left-hand groups, but the vertical shaft bevel of the central group engages with a second bevel on the left-hand shaft. The two magnetos, oil pumps and the water pump are all driven from off this end of the crankshaft through a bevel-shaft (and skew gear for the oil pumps) extending below the vertical shaft gear.

The crankshaft is supported on roller bearings except at the forward end, where it is mounted in a plain bearing housed in the metal of the reduction gear drum. The pistons are cast from a special aluminium alloy, and are very short: they are fitted with four rings. The gudgeon pins are hollow, and form the final oil-conduits to the cylinder walls.



The Napier "Cub" 1,000 h.p. 16-cyl. water-cooled engine: This view, showing the reduction gear end, gives a very good idea of the "clean" design of this remarkable engine.

The connecting-rod group consists of a central I-sectioned master rod, the big-end of which carries a white-metal lined bronze bearing, and has its shoe united in a scarf joint—attached by four studs. Anchored to lugs on the big-end, by hollow pins, are the side connecting rods, which are tubular.

Very careful attention has been paid to the lubrication of the "Lion" and in many instances difficult problems in this connection have been solved in a most ingenious manner.

The "Lion" may be started alternatively by electric motor or by hand, the same gear mechanism being used in each case. It is effected by a dog clutch sleeve with off-set faces on the teeth which give an easy cast-off as soon as the engine starts. The sleeve is freely mounted on the tail extension of the crankshaft, and is externally splined to carry—and slide freely through—a worm wheel, which is rotated by a worm spindle carrying the driven one of two encased spur gears. This spindle extends through the casing at either end, where it is formed to receive a starting handle. When using the electric starter, the cover of the worm spindle casing is lifted off and the motor with its driving spur pinion substituted and secured in place.

The "Cub" is a 16-cylindered water-cooled engine, remarkable, not only for its high horse-power of 1,000, but for its general lay-out. The cylinders are arranged in four banks of four, the two upper rows being set at about 50°, whilst the lower ones are at a very wide angle—only a little below the horizontal line, in fact. It is claimed that this arrangement has the advantage of relieving crankshaft stresses, whilst the general form is simple and easy to mould into an aeroplane to the best advantage, both aero-dynamically and in connection with the pilot's range of vision, points which should be appreciated by designers.

The "Cub" differs in several details from the "Lion." For instance, the separate cylinders of each bank are not united by a head block, but by the overhead camshaft, which operates the four valves of each cylinder. Two duplex carburettors, each supplying one upper and one lower bank, are mounted at the airscrew end of the engine, and ignition is supplied by four magnetos accessibly mounted on platforms at the rear end.

A large reduction gear, necessary in an engine of this high power, is provided. Further details, other than those indicated by the accompanying illustrations, we are not at liberty to publish as yet.

ROLLS-ROYCE, LTD.,

14-15, Conduit Street, London, W. 1.

THE name of Rolls-Royce needs no introduction to readers of FLIGHT, and the successes achieved by the aero engines produced by this firm, not only during the late War, but during the past few years of alleged Peace, are world-famous. Three of the aero engines now being manufactured by this firm are the following:—the 270 h.p. "Falcon," the 360 h.p. "Eagle," and the 620 h.p. "Condor." The former was used throughout the War in the famous Bristol Fighters, and the splendid work done by this combination of engine and machine is in itself a recommendation as to its value.

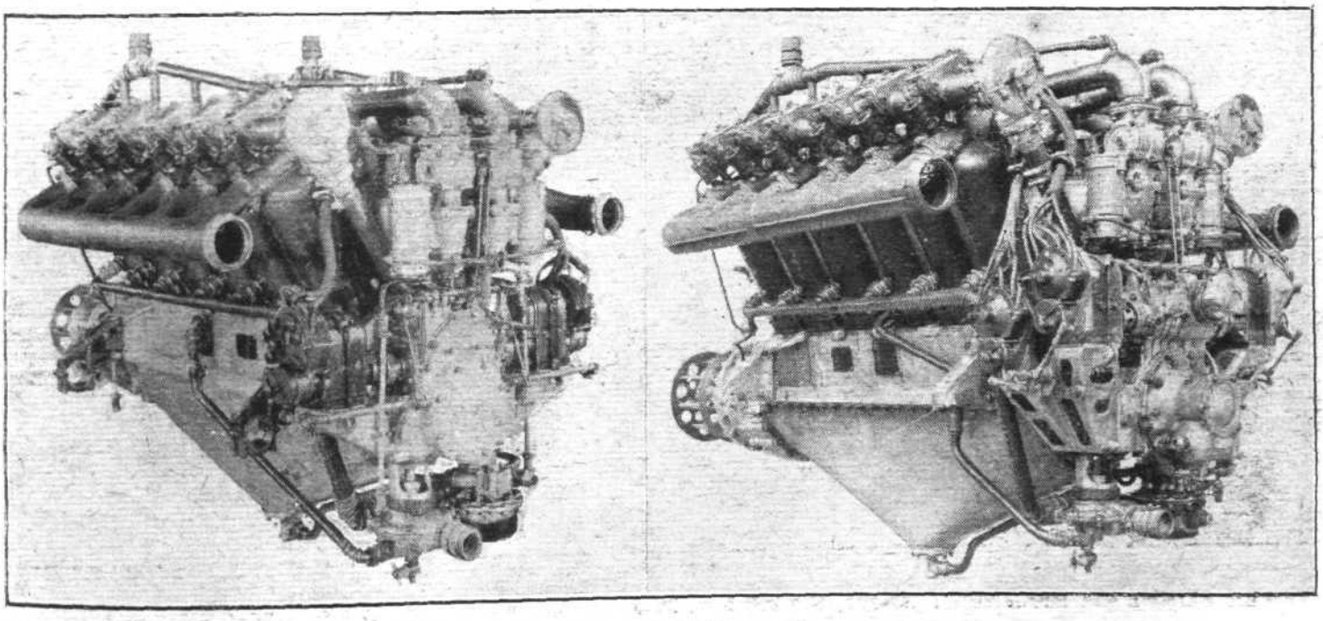
The "Falcon" is a 12-cylinder, water-cooled V-type engine, with the cylinders, of 4 ins. and $5\frac{3}{4}$ ins. bore and stroke respectively, separate. The normal h.p. of 270 is developed at 1,800 r.p.m.—the maximum r.p.m. being 2,000. An epicyclic reduction gear is fitted, giving an airscrew speed of 1,061 r.p.m. The petrol consumption at normal b.h.p. and normal r.p.m. is 18 galls. per hour, and the oil consumption .75 gall. per hour. The weight of the "Falcon," including reduction gear, but excluding radiator, water, oil and fuel, is 705 lbs. The valves are operated by overhead camshafts, driven off the rear end of the crankshaft by vertical shafts. Two magnetos, also at the rear end of the crankshaft, are fitted, and each bank of cylinders has two carburettors, a pair each end of the engine, each supplying three cylinders. The water and oil pumps respectively are located outside, at the rear of and below the crankshaft.

The "Eagle" is perhaps the best known of the Rolls-Royce aero engines, since it is the one associated with such historic records as the first direct aeroplane flight across the Atlantic the flights from England to Australia, from England to South Africa, whilst it has been doing excellent work for some time past on the various London-Continental air services.

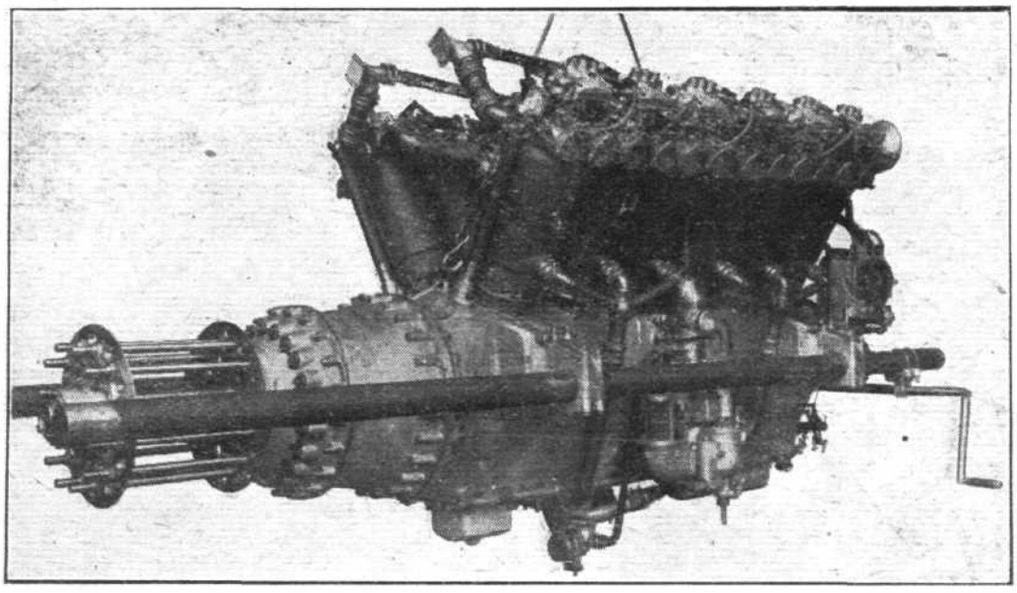
In general design the "Eagle" is similar to the "Falcon," being a 12-cylinder V, with a similar arrangement of cylinders, carburettors, magnetos, pumps and valve gear. The bore and stroke are respectively $4\frac{1}{2}$ ins. and $6\frac{1}{2}$ ins. An epicyclic reduction gear is fitted, giving a gear ratio of 0.6 or an airscrew speed of 1,080 r.p.m. The normal and maximum crankshaft speeds are 1,800 and 2,000 r.p.m. respectively. The petrol consumption is 25 galls. per hour, and the oil consumption 1 gall. per hour. The weight, with reduction gear, is 900 lbs.

The "Condor" is a comparatively recent design, and was manufactured at the request of the Government to meet the demand for an engine of high horse-power for carrying great weights for long distances. Like the two previous models, the "Condor" is a 12-cylinder V, water-cooled, but in certain details it differs from these engines. The chief difference is in the provision of four valves for each cylinder, these being set diagonally into the four quarters of the cylinder-heads, and are actuated X-fashion by four bell-crank rockers converging upon two cams. There are two carburettors, one on each side of the crank-case, each supplying two groups of three cylinders of its respective bank through six-branched, T-shaped manifolds.

The water connections are in four triplicate manifolds



Two Rolls-Royce 12-cylinder water-cooled "V" engines—the 275 h.p. "Falcon," on the left, and the 360 h.p. "Eagle," on the right, both with reduction gear.



The 600 h.p. Rolls-Royce "Condor," a 12-cylinder water-cooled "V" engine, fitted with reduction gear

outside the V, feeding to the bottom of the water-jackets. The connections for the water-collection are made in one lead by way of rubber and clamp-joint unions between the cylinder jackets, on the valve line. The four water inlets are supplied from a four-way centrifugal pump, located horizontally beneath the centre of the base chamber, and driven from the crankshaft through helical gearing.

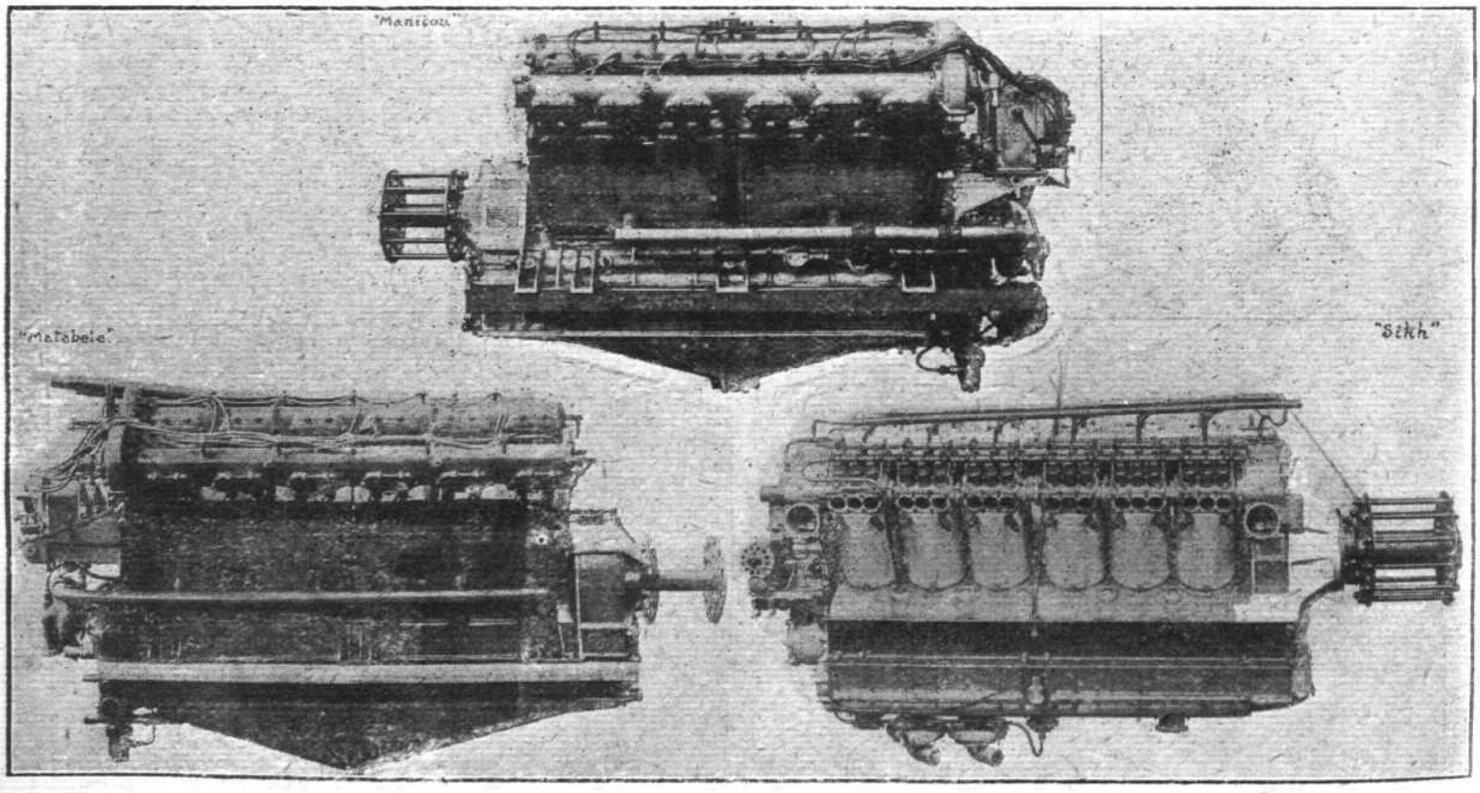
With a bore and stroke of 5½ ins. and 7½ ins. respectively, the normal h.p. of 620 is developed at 1,900 r.p.m. The epicyclic reduction gear gives an air screw speed of 1,055 r.p.m. The maximum crankshaft speed is 2,000 r.p.m. The fuel consumption at normal power and speed is 43 galls. per hour, and the oil consumption is 1.9 galls. per hour. The weight of the "Condor," including propeller hub, carburettors, magnetos, engine feet, electric starter and reduction gear, is 1,552 lbs.

THE SUNBEAM MOTOR-CAR CO., LTD.,

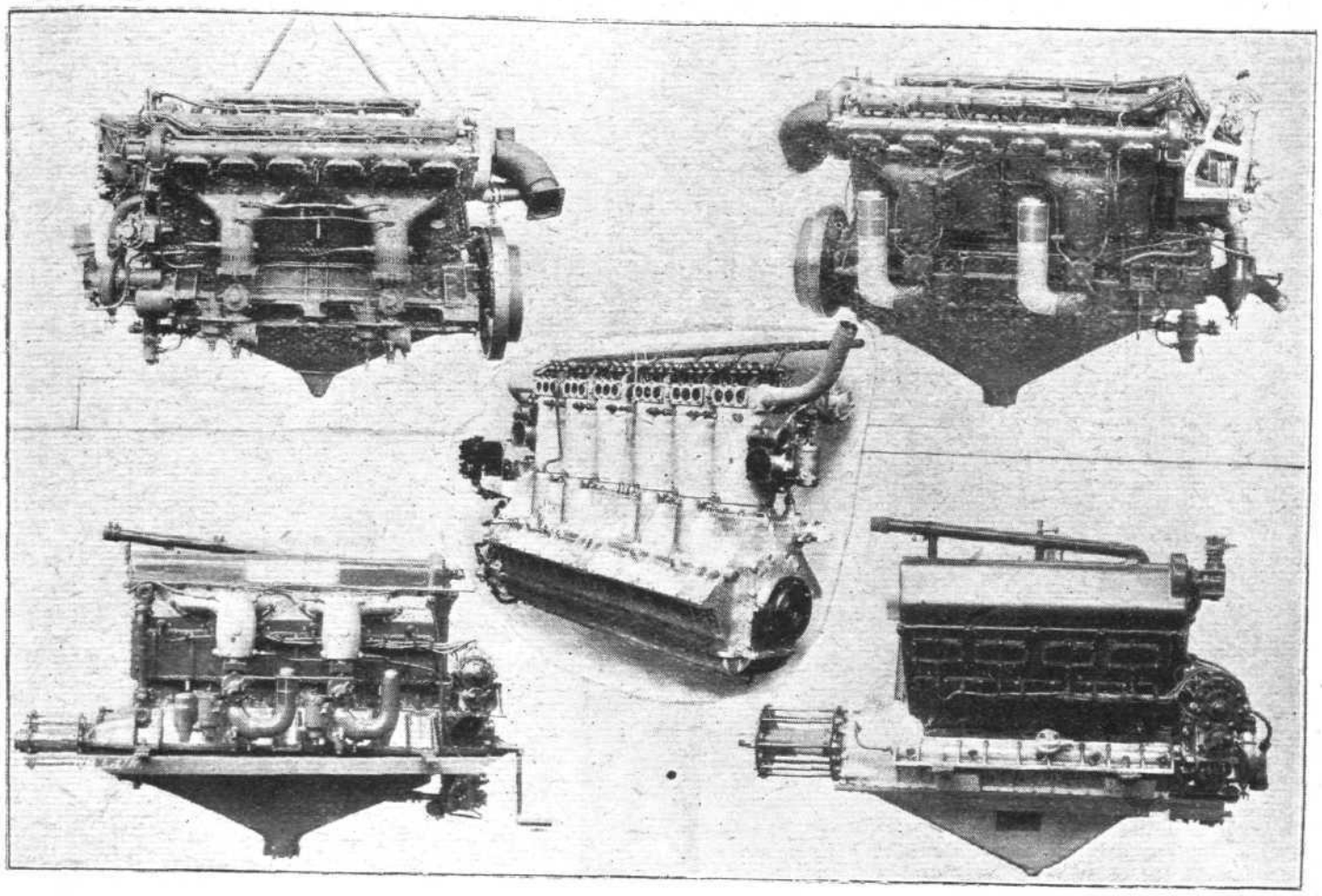
Wolverhampton

SEVERAL "tribes" of Sunbeam engines are on the aerial war-path, and are contributing no small amount to the Victory we are gaining—if not already gained—over the third and last Element to be conquered. There are, in fact, no fewer than eight distinct types of Sunbeam aero engines, designed to meet all the various requirements, whether for aeroplanes, seaplanes, or airships. All these types, it should be noted, have been passed by the Air Ministry as airworthy and suitable for civil aviation, in accordance with the provisions of the Air Navigation Acts (1911-1919).

The eight Sunbeam engines referred to are :—The 100 h.p. "Dyak," the 200 h.p. "Arab 2," the 300 h.p. "Manitou," the 400 h.p. "Matabele," the 800 h.p. "Sikh," the 275 h.p. "Maori," the 350 h.p. "Cossack," and the 400 h.p. "Sikh."



THREE SUNBEAM ENGINES : Above, the 300 h.p. Manitou ; on the left, the 400 h.p. Matabele, and, on the right, the 800 h.p. Sikh.



FIVE MORE SUNBEAM AERO ENGINES : At the top are shown the 275 h.p. "Maori" (left) and the 350 h.p. "Cossack," both 12-cyl. V-type ; in the centre is the 400 h.p. "Sikh." These three engines have been specially designed for use in airships. Below—from left to right—are shown the 100 h.p. "Dyak" (6-cyl.) and the 200 h.p. "Arab" 2 (8-cyl. V).

These engines, though varying somewhat in type, are generally composed of similar materials for similar parts. The crankshafts and the connecting rods in each case are of nickel chrome steel, and the pistons are of aluminium. The cylinders, with the following exceptions, are aluminium castings with steel liners and bronze valve seats. The exceptions to this are the two "Sikh" engines, in which the cylinders are composed entirely of steel, welded together with their jackets ; and the "Maori" and "Cossack" engines, in which the cylinder blocks are of cast-iron.

In all the engines the valves are made of high chrome steel, the crankcase of aluminium, and the valve gears of self-hardened nickel-chrome steel. They are all of the water-cooled type, the circulation being in each case by centrifugal pump, and the lubrication is on the dry base principle, by gear wheel pumps. Claudel-Hobson carburettors, diffuser type, are fitted, and ignition is by means of high-tension magnetos in all cases. Two plugs per cylinder are provided on all the engines except these of the "Sikh" type, which have four plugs per cylinder.

Dealing with each engine, separately, the principal characteristics of each are as follows :—

The 100 h.p. "Dyak" is a six-cylinder vertical, monobloc type, having a bore and stroke of 120 mm. and 130 mm. respectively. It was designed for small airships, but it is equally suitable for aeroplanes. The normal speed of the engine is 1,200 r.p.m., and the fuel consumption is 0·54 pt./h.p./hr. Two carburettors and two magnetos are fitted. The airscrew drives direct from the crankshaft, and a hand-starting gear is provided. The weight of the "Dyak" dry is 399 lbs.

The 200 h.p. "Arab 2" is an eight-cylinder engine with the cylinders cast in two blocks and set at an angle of 90°. The bore is 120 mm. and the stroke 130 mm. The normal speed of the engine is 2,000 r.p.m. There are three valves to each cylinder, one inlet and two exhaust, operated by two overhead camshafts driven by bevel gear through intermediate shafts. Carburation is by a single carburettor set between the cylinder blocks. The airscrew drive is direct, and the engine may be adapted either for hand or electric starter. The weight of the engine, dry, is 517 lbs.

The 300 h.p. "Manitou" is a general purpose engine suitable for all types of aircraft. It has 12 cylinders cast in blocks of three set in two banks of six at 60°, and has a bore and stroke of 110 mm. and 135 mm. respectively. There are four valves to each cylinder, operated by overhead camshafts driven by trains of gears. Two carburettors are set between the cylinder blocks, and two 12-cylinder magnetos supply the ignition. A reduction gear of 1·57 to 1 is employed. Both electric and hand starters are fitted. The weight of the engine dry is 845 lbs.

The "Matabele" is also a general purpose engine, and is similar in general design to the "Manitou." Its bore and stroke is 122 by 160 mm., and its normal speed 2,000 r.p.m. The weight dry is 1,000 lbs.

The "Sikh" 800 h.p. is a 12-cylinder V-type (180 mm. by 210 mm.) with reduction gear, and weighs 1,952 lbs., whilst the 400 h.p. model is a 6-cylinder vertical (of the same bore and stroke) specially designed for airships. The 275 h.p. "Maori" and the 350 h.p. "Cossack" are both 12-cylinder V-engines, also specially designed for airships, and are somewhat similar in design. The former has a bore and stroke of 100 mm. by 135 mm., whilst the latter has a bore of 110 mm. and a stroke of 160 mm.

WOLSELEY MOTORS, LTD.,

Birmingham

WE understand from Wolseley Motors, Ltd., which is, as most of our readers are aware, a branch of Vickers, Ltd., that they are not, at the present moment, interested in the manufacture and sale of aero engines.

THE · PARIS · AERO · SHOW · 1921

BY THE TECHNICAL EDITOR

THE following notes and illustrations from the Paris Salon were dispatched by Handley Page aeroplane. They were handed in at the Handley Page Paris Office, Rue Royale, at 10 a.m. on Monday. They arrived at our office at 3·15 p.m. Monday. This is a typical example of the saving in time which can be effected by sending parcels and goods by air. In no other way would it have been possible to get the sketches and photographs through in time to have blocks made for this week's issue of FLIGHT.—ED.

LARGE machines dominate this year's Salon. Although they are outnumbered by the smaller fry, their wings seem to cast their shadows over the whole of the Grande Nef, and to claim attention by their very size. Towering in some instances with the noses of their *fuselages* over the gazing pigmies walking below, they undoubtedly form the chief attraction as regards the general public. There is a steady stream of people climbing up the steps that lead to the "Pullman" cabins, and the queues remind one of London during the War. From the practical point of view, however, it is extremely doubtful whether these "Mammouths," "Leviathans," and "Juggernauts" deserve the prominence which their size gives them. There is still much to learn in a smaller way before we can profitably turn to these giants, and unless a full load can be guaranteed for each trip (which may be doubtful), they are likely to prove disappointing to run until flying becomes more popular with the general public than is the case at present. Regarded purely as aeroplanes, these large multi-engined machines are, of course, just as interesting as, if not more so than, the smaller ones, and from that point of view they will repay a close study. Also it should be borne in mind that France's policy in the air is vastly more vigorous than ours, and that the next few years will undoubtedly see an enormous increase in the already great extent of France's "airways." Some of these are planned for long distances, where the really large machine may prove more suitable. From the point of view of French constructors, therefore, it may well be that there are better prospects for the large multi-engined machines than one is at first inclined to think. It appears to the writer that we at home have gradually and, perhaps, unconsciously been slipping into the habit of thinking in terms of the London-Paris service, and that as a consequence we may be apt to lose sight of the far greater possibilities which are revealed when one looks farther afield.

From the constructional point of view, one's impression of the Show is that, although not a great deal of progress is evidenced, the general tone of the collection of some 40 machines is better than that of the Salon of 1919. There is a total absence of "freak" machines, and altogether the designs appear less the inspiration of artists and more the result of engineers' work than has previously been the case.

A good many examples of metal work are shown, indicating the increased interest which France is taking in this form of construction, but after a brief examination of these, one feels that the design is not yet on a par with that of England and Germany. It is true that several of the specimens are not new, although exhibited for the first time, and that this may account for them being of a form which was discarded long ago by us. Nevertheless, the fact of this revived interest in France should be a warning to us not to rest content with what we have achieved—even if it is only on a small scale—but to see to it that research work is not allowed to be dropped.

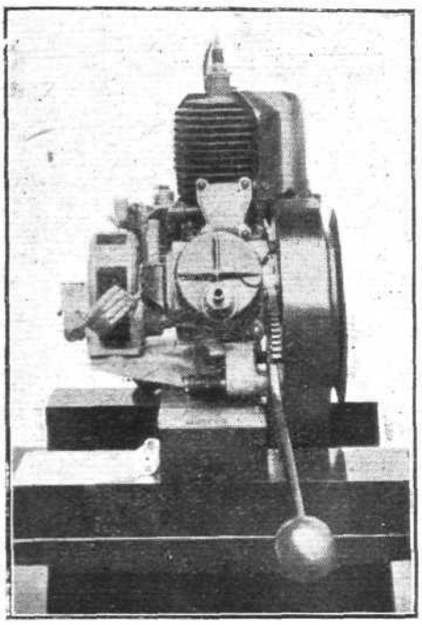
Paris Aero Show: M. L. Eynac, Assistant Secretary of State for Air, arriving at the Grand Palais on November 12.

One thing which impresses one is that, although there are still several examples to be seen, the use of piano wire is far less general than has previously been the case, several constructors having abandoned it for streamline wire for the wing bracing. Hitherto, several French constructors have used piano wire for the wing bracing of even very large machines, with the result that the wire was often of very heavy gauge and most unsatisfactory when bent over and locked with a ferrule.

Among the larger machines the use of three engines seems to gain popularity. From the point of view of reliability, this arrangement is quite good, as the stoppage of one engine reduces the power by one-third only instead of by one-half. Also, the turning moment is, generally speaking, smaller for a given power in the three-engined type than in the twin. As regards the efficiency the advantages are, perhaps, more problematical. The presence of a central tractor increases the drag on the main *fuselage*, owing to the slipstream, and it is said that in the case of one firm which has experimented with three-engined machines it was found that the machine was very little faster when the third engine was fitted than it was in its original form as a twin-engined machine.

If one's recollection serves, no French four-engined machine has ever been exhibited at the Grand Palais until the Blériot "Mammouth" was shown in 1919. This year there are two machines with four engines on the wings, and one with four in the *fuselage* driving a single tractor screw.

Of novelties there appear to be but few, but. generally speaking, the lack of these is more than compensated by the absence of "freaks" and the general improvement in design. As usual, the finish is, with few exceptions, excellent.



The "Bristol" engine starter.

The absence of British machines is much to be regretted, the more so as the two examples shown indicate how well British products would have fared by comparison. The Vickers-Vimy Commercial with two Napier "Lion" engines is a very fine machine and well shown. It is sold to the Grands Express Aériens, and exhibited on the Stand of the Atéliers des Mureaux. The Bristol "Jupiter" radial air-cooled engine is a fine specimen of the British aero engine manufacturer's art, and is, with the Bristol Starter, attracting a great deal of attention from "those who know." The engine is dealt with on p. 751.

With these brief remarks we will leave general subjects and give a brief *résumé* of each of the machines shown. In next week's issue we shall commence a detailed illustrated description of the various machines and engines.

ANSALDO AÉRONAUTIQUE

AT the moment of writing this Stand is empty. According to the catalogue, this firm will exhibit a cabin machine, but beyond this fact no information is available at present.

ATÉLIERS DES MUREAUX

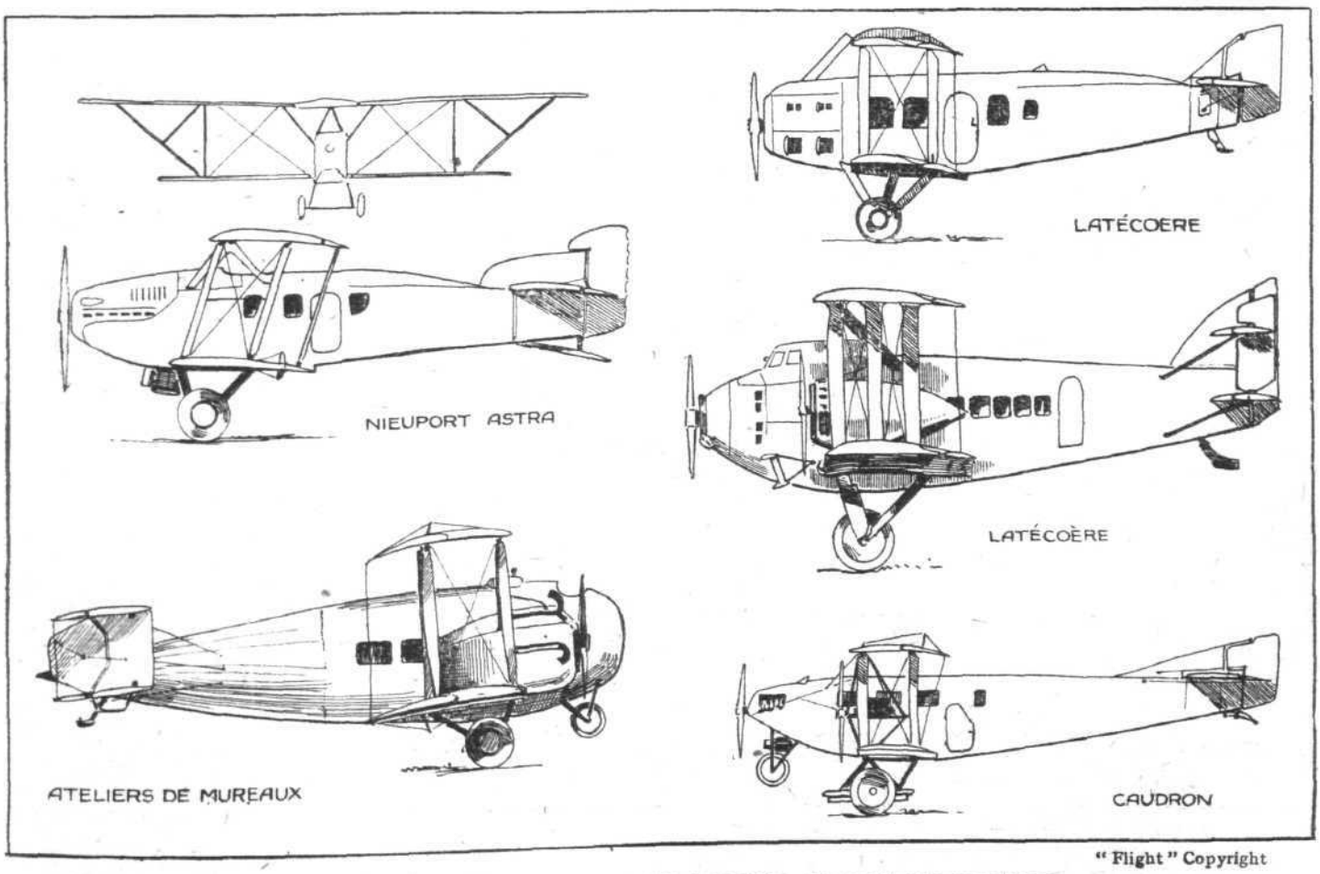
ALTHOUGH the banners over this Stand bear an unfamiliar inscription, the machine looks familiar enough, being the Vickers-Vimy Commercial with two Napier "Lions." Generally speaking the machine resembles the older type, except for minor alterations. The cabin is roomy and well lighted, and the comfort of the passengers has been well considered. The machine is to be used by the Grands Express Aériens, presumably on the London-Paris route. It is extremely gratifying to find a French firm using a British machine for their commercial service. In a subsequent issue of FLIGHT we propose to give an illustrated detailed description of this machine.

MARCEL BESSON

THIS constructor, who has made a speciality of seaplanes, is showing a small single-seater flying boat of very unusual design. Of the type H.6, the machine is a tractor triplane with Clerget engine. The pilot sits aft of the planes, and consequently does not obtain quite such a good view as in a pusher boat. The planes are of very unusual arrangement, the lower having the greatest span and chord. The middle plane is shorter, while the top plane is quite a small affair. There is only a single strut on each side, and these have a pronounced inward slope. There are no flying nor landing wires, the more or less triangulated structure being apparently able to retain its shape without the use of bracing.

BLÉRIOT AÉRONAUTIQUE

THREE complete machines are exhibited by Louis Blériot, all of the Spad type. By far the most interesting of these is the type 45, a large four-engined machine designed to carry



SILHOUETTES FROM THE PARIS SALON: Some large machines.

20 passengers. It is a vast improvement on the "Mammouth" shown in 1919, and bears unmistakable signs of M. André Herbemont's work. In spite of its large size, the machine has only one strut on each side, these being of the type found in nearly all the Spad-Herbemont machines, with cable bracing running to front and rear spars. The engines—400 h.p. Hispanos—are mounted in tandem on the wings. This is undoubtedly an improvement on the spread-out arrangement of the engines of the "Mammouth," and altogether the machine is, thanks to M. Herbemont's genius, a very much more practical proposition than was the older type. The use of only a single strut for a machine having four engines on the wings is somewhat startling, but the manner in which the design is carried out appears to be satisfactory, and in any case M. Herbemont is not likely to be led astray by captivating schemes unless he sees a practical solution for them.

In addition to the large machine, a small two-seater side-by-side school biplane is shown. This is the type Spad 34, with Le Rhone engine. It generally resembles the other Spads in its lines. A Spad "Berline" of the type used on the London-Paris service is also shown, but as this machine is already well known to readers of FLIGHT, no reference is necessary beyond stating the fact of its presence.

LOUIS BREGUET

THE only new complete machine shown by Breguet is a type 19A² all-metal biplane, designed as a fighter, with pilot in front and a gunner aft, equipped with a Scarff gun ring. The machine has only one strut on each side, and these appear to be of sheet duralumin with possibly a channel section stiffener inside. At the ends these struts are forked to meet the two wing spars. Owing, presumably, to the fairly small size of the lower plane, this machine is referred to as a "Sesquiplan." The power unit is a double-row Breguet-Bugatti of 450 h.p., and the machine is credited with a speed of 231 km./hours.

The "Leviathan" all-metal *fuselage*, which has been under construction for probably two years, has duralumin tube *longerons*, with frames of zigzag pressed duralumin bars similar to those of a Zeppelin, but not arranged as crosses. The bracing is by tie-rods. The power unit is a Breguet-Bugatti "Quadrimotem" similar to that shown in 1919. It has automatic clutches so that one or more of the units can cut out without interfering with the others. There is a single tractor screw formed by two two-bladers placed at right angles.

The *fuselage* of a type 14T bis "sanitaire" is also shown, and a five-passenger 14T bis of the old type. A wide seaplane float in duralumin is evidently designed for a large single-float seaplane.

ÉTABLISSEMENTS CAUDRON

ON the Caudron stand the largest machine is a three-engined cabin biplane with Hispano engines. The machine is not unlike that shown in 1919, but looks more refined. For instance, one is glad to note that streamline wing bracing is used instead of piano wire. The central engine is mounted in the nose of the *fuselage*, and the wing engines on the sides of the interplane struts, with supporting tubes running from the bottom plane up to the outer engine bearers. A four-wheeled undercarriage is fitted, and there is a small wheel under the nose of the *fuselage*.

A type C60, similar to that used by Poiree, is also shown, as well as one of the pre-War types with open tail booms. One notices that in the latter machine *ailerons* are fitted. The exhibits are completed by the *fuselage* of a C59 type, which appears to resemble the C60 except for having a Hispano engine.

CLEMENT AND SANCHEZ-BESA

THE only thing on this stand which appears to have any connection with flying is a metal *fuselage* which appears to have been made for a glider. The remaining exhibits consist of canoes, etc. Somewhere in the gallery M. L. Clement is, we understand, showing metal parts and fittings.

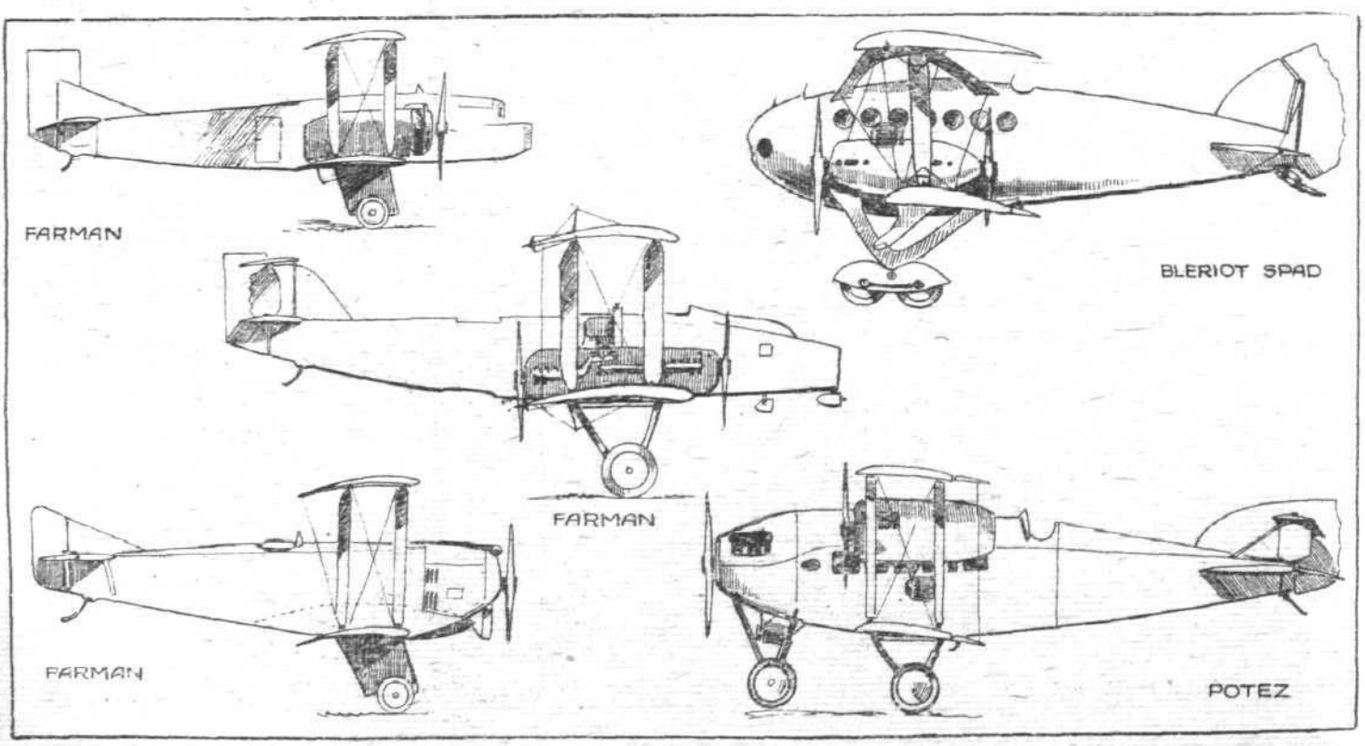
H. AND M. FARMAN

THIS is an imposing stand, chiefly owing to the presence of a huge four-engined machine. This is a biplane with 400 h.p. Lorraine-Dietrich engines placed in two pairs in tandem on the wings. The arrangement of the *ailerons* is unusual, the trailing edge of each *aileron* forming a separate hinged unit connected to the rear main spar by rods attached to cranks. The effect appears to be that when an *aileron* is moved down, its trailing edge tilts upwards and vice versa.

Farmans also show a torpedo-'plane, not unlike the famous "Goliath," but having a deep *fuselage* with open cockpits and a torpedo resting in a large semicircular groove in the floor of the *fuselage*. Apart from these differences, the machine is unlike the "Goliath" in having a single engine in the nose of the *fuselage*. A twin-engined machine with Salmson engines is also shown. This is practically a "Goliath" with minor modifications, notably an open cockpit in the nose of the *fuselage*, apparently intended for the navigator. A small "Farman Sport" completes the exhibits.

F.B.A.

THE Franco-British Aviation Co., of which M. "Beaumont," otherwise Lieut. Conneau, of Circuit-of-Britain fame, was a director, is exhibiting a fine piece of workmanship in the form of a fairly large boat hull, fitted with amphibian land gear, the wheels evidently being so arranged as to swing outwards under the bottom plane. A smaller boat hull is also shown, and a pair of wings, one in skeleton.



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SILHOUETTES FROM THE PARIS SALON: Some more large machines.

AVIONS HANRIOT

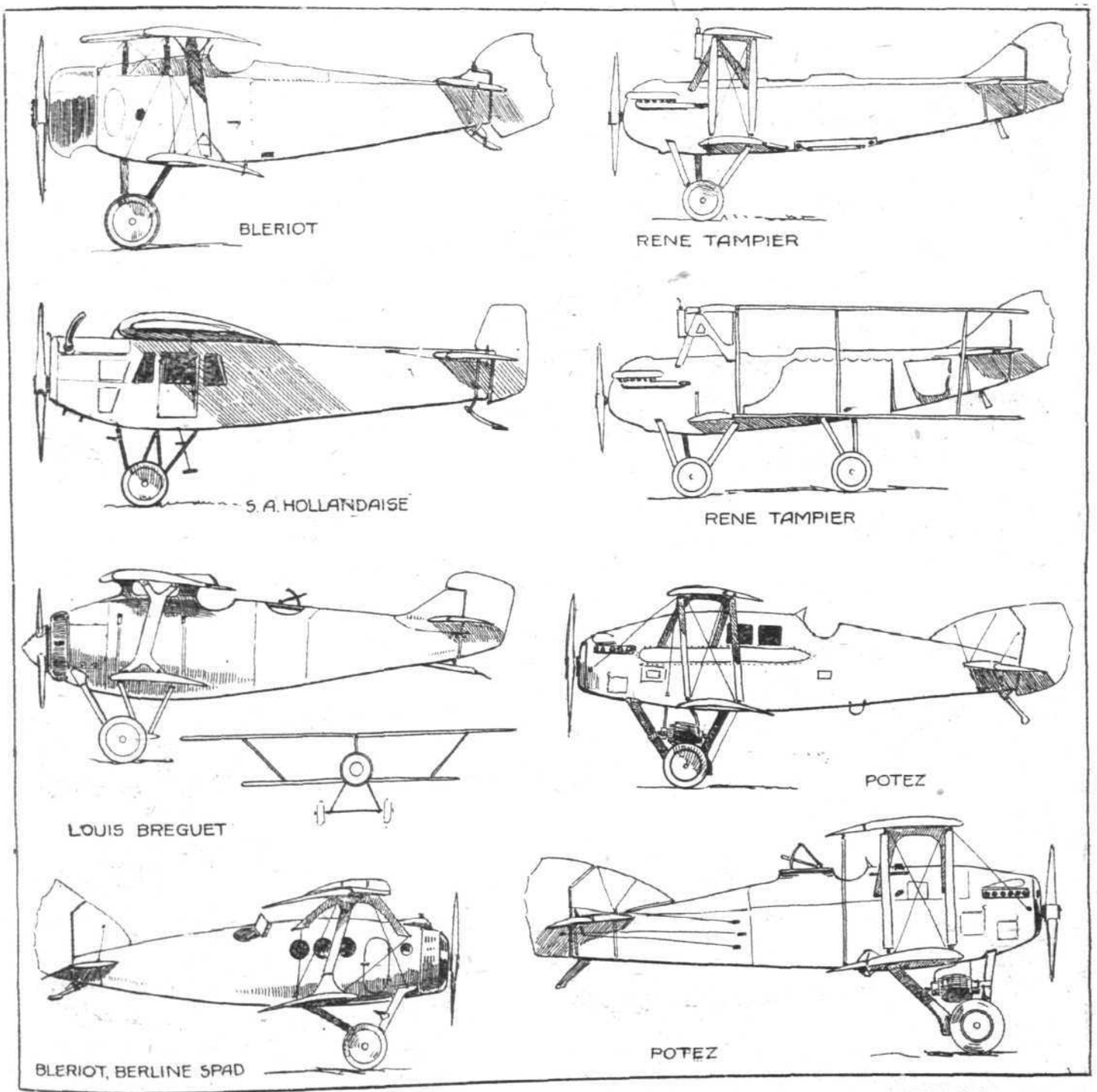
By far the most interesting machine on this stand is the all-metal racing monoplane built for, and which was to have been flown by Rost in, the race at Etampes for the Deutsch Cup. This machine is a very fine piece of work and demands a full description, which we hope to publish in next week's issue of FLIGHT, if possible with sketches of the detail construction. The *fuselage* is entirely covered with sheet aluminium, as are also the *ailerons*. The wings themselves are fabric-covered in the ordinary way, and might conceivably have given the same trouble as did those of the other machines. Otherwise we must admit that the Hanriot gives the impression of great strength, and it certainly looks capable of extremely high speeds. Everything is well streamlined, and the cantilever wings, although of deep section and consequently probably not of very high L/D., have no external bracing or fitments to offer extra resistance. One had hoped to see the machine shown with the retractable under-carriage, but an ordinary one is fitted at the Show. The only other exhibit on the Hanriot stand which calls for reference is a type H.D.14 school machine. This has a rotary engine and a four-wheeled skid under-carriage.

PIERRE LEVASSEUR

Two interesting machines are shown on this stand. One is a torpedo-'plane, very much like the Blackburn "Swift." This machine is shown in skeleton, and gives a good idea of the excellent workmanship of this firm, of which M. Charles Fréchet is a director. M. Fréchet was French Liaison Officer in England during the War, and always makes English visitors welcome on the Levasseur stand. Needless to say, he speaks English fluently. The machine has the whole front portion of its *fuselage* built in steel tubing so as to form a strong separate unit. The engine is a 600 h.p. Renault.

The second machine shown is a side-by-side biplane, suitable for school work. It is of most extraordinary design, with a streamline body. The centre-section struts form a vee, with its apex in the central member of the undercarriage and the other to points on the spars of the top plane. The wings are in one piece, the lower being slipped between the chassis members. The rear portion of the *fuselage* is formed by two multi-ply members forming a kind of wedge, the outer covering of the *fuselage* being merely a streamline casing taking no part of the load. The machine should be cheap to make and easy to repair. We shall refer to it in detail later.

A variable pitch propeller is also shown. This, we are informed, has just successfully passed its tests at the *Section Technique*, having completed a 10-hours' run. It was found that the pitch could easily be altered at all speeds up to the full speed of 1,800 r.p.m.



SILHOUETTES FROM THE PARIS SALON: Some medium-sized machines.

LATÉCOÈRE

LIGNES AÉRIENNES LATÉCOÈRE are showing two complete machines, and a huge *fuselage* in duralumin. The type Lat. 4 is a cabin machine with three Salmson engines, one in the nose of the *fuselage* and two on the wings. The total power is stated to be 1,000 h.p., so that the Salmsons are rated at 333 h.p. each. The cabin has room for 20 passengers, and the total weight is given as being 7,000 kg. (about 15,000 lbs.). The machine is credited with a speed of 180 km. p. hour.

The second complete machine is of the type Lat. 8, with an enclosed cabin, and a single engine. The pilot is placed aft of the cabin. The machine bears the inscription "France-Spain-Morocco."

The large all-metal *fuselage* is for an "Avion de Protection" day-bomber, and must have cost a fortune to build. There are no *longerons* and struts, nor bracing, in the ordinary sense of the word. A number of longitudinal members are triangulated by diagonals running spirally around the streamline *fuselage*. All are of channel section, the diagonals having lightening holes in them.

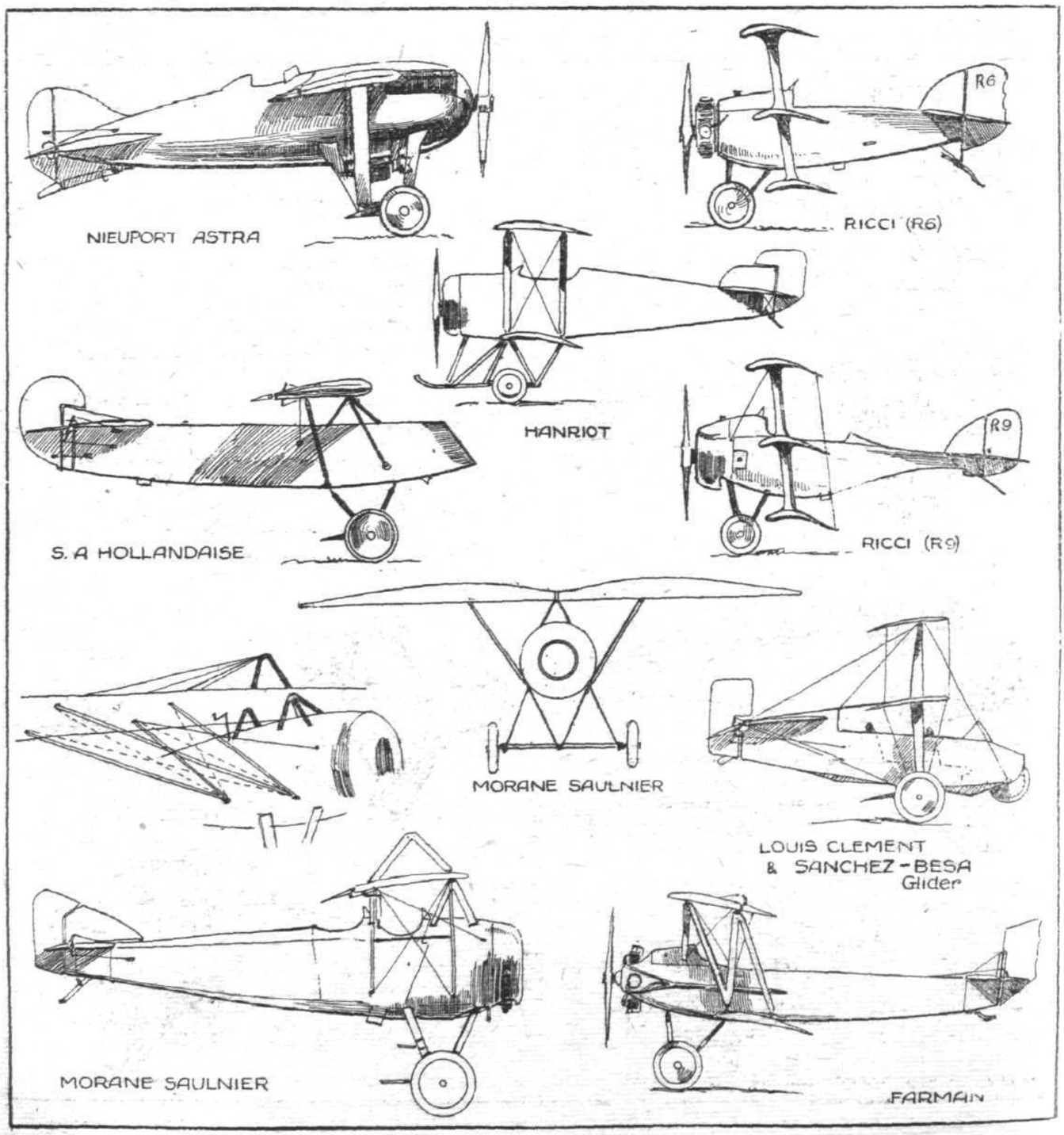
LOIRÉ ET OLIVIER

THIS firm, which showed a very original three-engined flying boat in 1919, is represented by a single machine, a type LEO 9 "Avion Monoplace de Chasse." It has a thick, high-lift monoplane wing placed at the floor of the *fuselage* à la Junkers. The wing is of uniform chord and thickness, and is of the cantilever type. The front portion of the *fuselage* is covered in aluminium and there is a nice spinner over the propeller boss. Except for its cantilever wing the machine does not appear to have any remarkable features.

MORANE-SAULNIER

ONLY two machines are shown by M. S. this year, both parasol monoplanes. One is of the school type with wire bracing and is already well known. This was the type which was flown by Fronval with controls locked. It has also to its credit the flight from Paris to Bucharest with 4 landings. The engine is an 80 h.p. Rhone.

The second machine is an experimental monoplane with cantilever wings. These are chiefly remarkable for the fact that they are thin at the root and tips and thick at the point where the centre-section struts are attached. The machine, which is a single-seater, has been flown, but one understands that various minor modifications are still necessary before it is considered ready for series production. It is known as the M. S. type AU.



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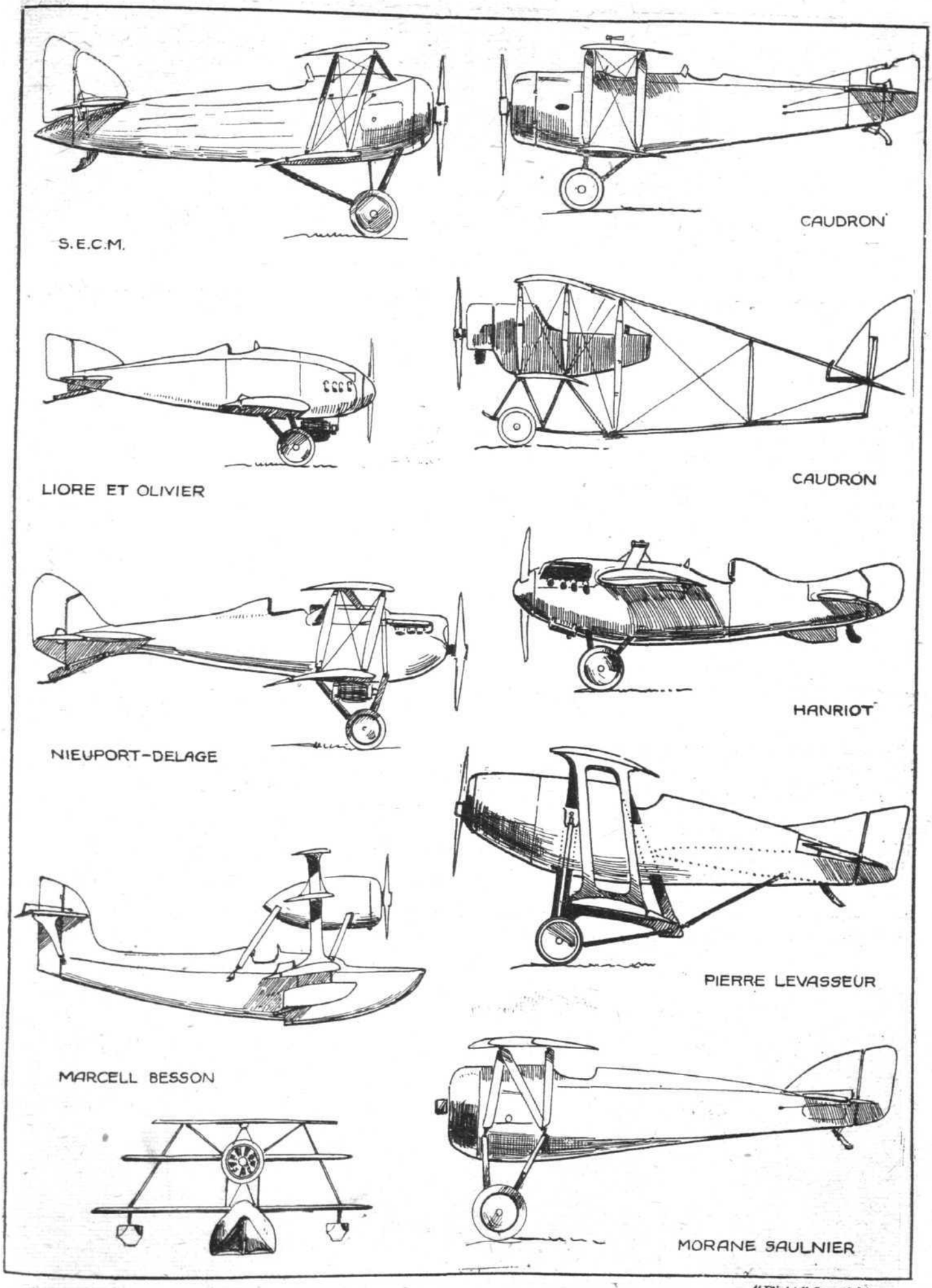
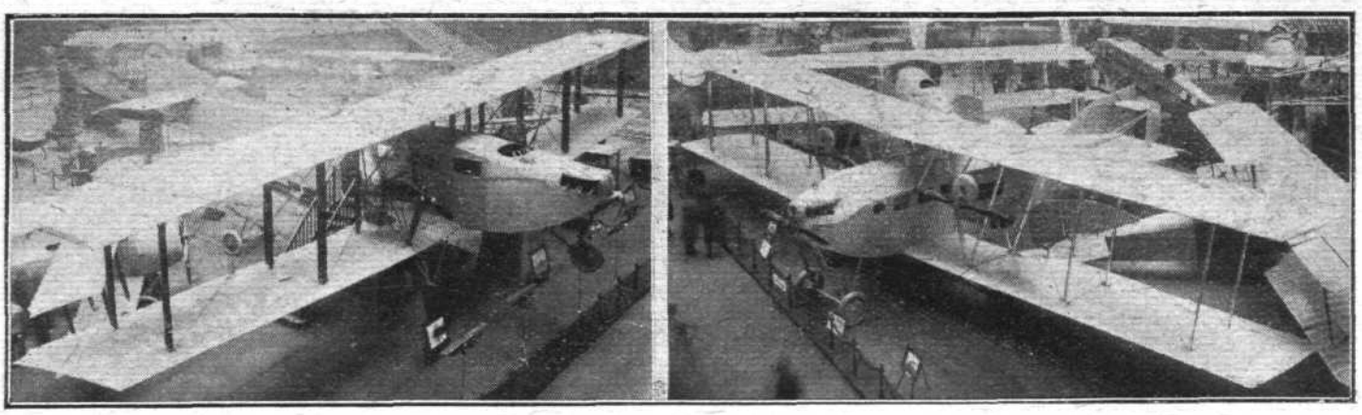
SILHOUETTES FROM THE PARIS SALON: Some of the smaller fry.



SILHOUETTES FROM THE PARIS SALON: Some more small machines.



THE PARIS SALON: Two large three-engined machines, the Caudron (left) and the Potez (right).

NIEUPORT-ASTRA

THREE machines are exhibited, neither of them new. One is a cabin machine, biplane with thick wings and backward stagger, and appears to be the same as that shown in 1919, when it was announced that it was intended for the London-Paris service. An interesting exhibit is the "Sesquiplan," flown by Kirsch in the race for the Coupe Deutsch. This machine is very effectively mounted at a terriffic angle of banking, reminding one very much of the late Commander Porte flying the "Thunderbug," at Hendon in the days before the War. The third machine is the type 29 biplane, which, although not new, is still one of the finest single-seaters in the world. Under the gallery is shown the car of an Astra airship.

HENRY POTEZ

COMPARED with the machines exhibited at the last Paris Salon, the three Potez machines are a great improvement. One is a military two-seater of orthodox design, with a gunner's seat aft of the trailing edge of the wings. The engine is a 400 h.p. Lorraine mounted in the nose of the *fuselage* and driving a tractor screw.

A limousine is also exhibited, with cabin enclosed and the pilot placed aft of the cabin. The front portion of the *fuselage* has a generous curving of aluminium. This machine also has a 400 h.p. Lorraine engine, and is known as the type IX.

The most interesting machine on this stand is, however, the all-metal three-engined passenger machine. The two wing engines are mounted in vees, under which occur the oleo undercarriages. A similar undercarriage is mounted under the nose of the *fuselage*, where is installed the third Hispano. The engines are of 150 h.p. each, and the machine should consequently be very economical to run. With regard to the detail construction we hope to have something to say in a subsequent issue.

RICCI FRÈRES

THIS Italian firm is showing two diminutive triplanes, one a single-seater and the other a two seater. At the moment, the span of the two machines is not known, but it only appears to be about 15 ft. Judging from a specimen bottom plane, the wings have but a single spar, and that only measuring about 1½ ins. in depth by a thickness of approximately 1 in. Although this may be sufficient for resisting bending stresses, it appears wholly inadequate for torsion. However, the single-seater type R6 is said to have been stunted in Italy, and is shown without alteration, just as it looks after having made about 100 flights. The engine of this machine is a 6-cylinder 35–40 h.p. Anzani.

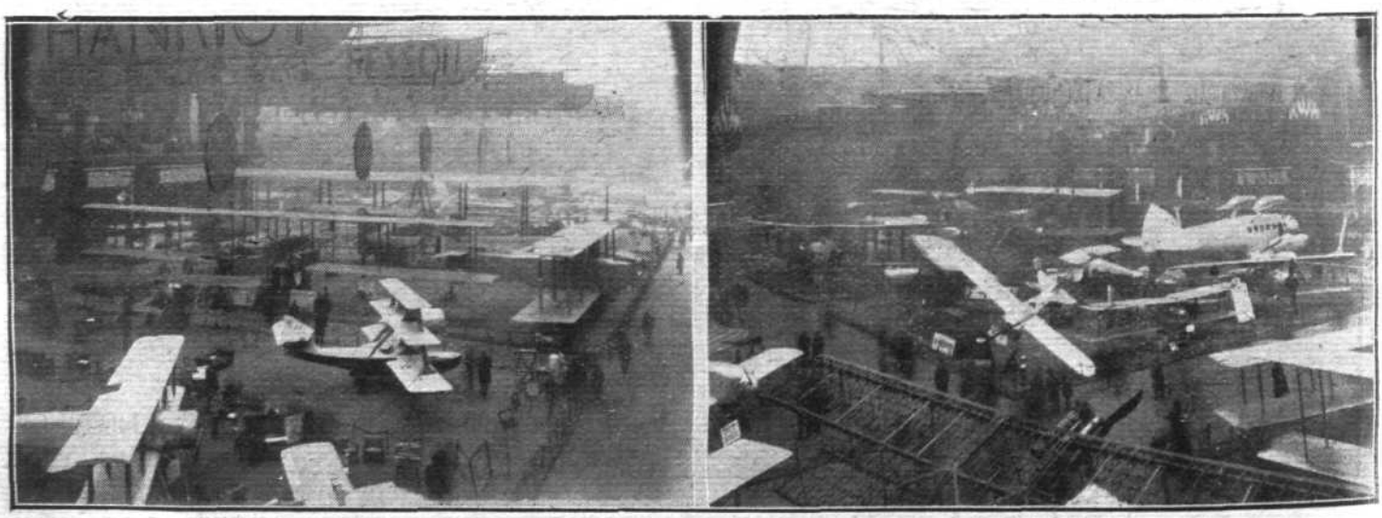
The two-seater type R 9, has a 50–60 h.p. Le Rhone engine, almost totally cowled-in, but appears otherwise very similar to the R 60. Both machines have this characteristic that towards the tail the *fuselage* changes from a rectangular to a triangular section. The consequence is a certain weakness in appearance, which is, however, probably more apparent than real. The machines are obviously the last word in lightness of construction, and should have a fairly good performance.

S.E.C.M.

THE machine shown on this stand is a dual control, side-by-side school machine (Letece type XX). Its chief claim to attention appears to be that it is fitted up with navigation lights on the wing struts, and has a searchlight under the lower port wing and a windmill drive generator under the starboard plane.

SOC. AN. HOLLANDAISE DE CONSTRUCTIONS AÉRONAUTIQUES

OTHERWISE known as N. V. Nederlandsche Vliegtuigfabriek is an "abbreviation" of Fokker. This famous designer is showing an F3 230 Siddeley "Puma" engine. As this machine is already so well known from its work on the London-Amsterdam route no reference to it is necessary, beyond mentioning that an emergency exit has been provided in the roof, through an opening in the wing. This was suggested in FLIGHT when we published our illustrated description of the machine.



Paris Aero Show. General Views in the Grand Palais.

Fokker also shows a neat little cantilever monoplane glider, fitted with an ordinary two-wheeled undercarriage. Although engineless, this machine appears to retain all the Fokker characteristics, and one would know it for a Fokker anywhere.

RENE TAMPIER

ON Friday last, as we approached the Grand Palais, we were treated to the strange sight of an aeroplane with folded wings travelling up and down the Avenue Alexandre III under its own power. That is to say, the propeller was not running, and the Hispano engine also seemed stationary. The machine made a good speed, and appeared to travel backwards as well as forwards. Steering was effected by a pair of wheels mounted approximately half-way between the wings and the tail, and corners were taken in reckless fashion, somewhat in the manner of certain American fire-engines which have rear-wheel steering.

A visit to the Tampier stand reveals the fact that this machine is provided with a small auxiliary engine with transmission to the main aeroplane wheels, which are provided with a differential, motor-car fashion. Some distance aft on the *fuselage* is another pair of wheels, mounted on a folding chasis structure, and so connected up to the rudder controls that they are steered by the same movement. The idea, of course, is that in case of a forced landing one can proceed by road under one's own power to the nearest place where repairs can be effected. The idea is sound, but naturally the extra engine and gear run away with a considerable proportion of the disposable load.

In concluding this week's article, one must express satisfaction that, in spite of the poor show made by Great Britain, there appears to be one component which is invaluable. Practically speaking, every machine at the Show is fitted with Palmer wheels.

Married

Flying Officer HENRY LAWRENCE CHRISTIE, R.A.F., only son of the late Lawrence Christie, of Rawal Pindi, India, and Mrs. Christie, was married on November 5 at St. Mary Abbot's, Kensington, to HELEN, only child of C. E. THEODOSIUS, late H.M. Inspector of Schools, and of Mrs. Theodosius.

PAUL COPELAND MALTBY, D.S.O., A.F.C., R.A.F., Quetta (late Royal Welch Fus.), was married on October 25 at Malabar Hill Church, Bombay, to WINIFRED RUSSELL, eldest daughter of J. H. PATERSON, 6, Moray Place, Edinburgh.

To be married

The marriage will take place at the end of November between FRANCIS WILLIAM LONG, R.A.F., only son of the Rev. F. P. Long, of 5, Winchester Road, Oxford, and DOREEN LANGLEY, eldest daughter of the Rev. F. L. APPLEFORD, Rector of Castle Combe, Wilts, and of Mrs. APPLEFORD.

Item

The will of the late Mr. HARRY GEORGE HAWKER, of Ennadale, Hook Road, Surbiton, Surrey, the famous aeroplane pilot, who died in an aeroplane accident near Hendon on July 12, aged 40, has been proved at £5,438.

The will of the late Maj. EUGENE COURTENEY PERRIN, O.B.E., of St. Mark's Road, Leamington Spa, Warwick, 4th Cheshire Regiment and R.A.F., has been proved at £1,027.

Air Staff Changes

BRIG.-GEN. R. K. BAGNALL-WILD, Director of Aeronautical Inspection at the Air Ministry, has been appointed Director of Research in succession to Air-Commodore H. R. M. Brooke-Popham, who will take up his duties as Commandant of the R.A.F. Staff College, Andover, next April.

A Manchester Memorial for the Atlantic Flight

A MEMORIAL tablet has been placed in the Sculpture Hall of the Manchester Town Hall as a permanent record of the achievement of Capt. Sir John Alcock and Lieut. Sir Arthur Whitten Brown, the first aviators to fly the Atlantic. The memorial, which represents symbolically the conquest of the air, is a bronze relief plaque by Mr. John Cassidy. Two gold medals, also the work of Mr. Cassidy, had been struck for presentation to the two aviators, and that intended for the late Sir John Alcock was handed to his father.

Kinshasa-Stanleyville (Belgian Congo) Air Mail Service

THE Postmaster-General announces that the Administration of the Belgian Congo has made arrangements whereby correspondence from this country for the Upper Congo may be forwarded by the aeroplane service which is now working between Kinshasa and Stanleyville (and intermediate points) in close connection with the arrival and departure of the Belgian packets from and for Europe.

The transit from Kinshasa to Stanleyville is due to be accomplished by air in three days, as against 14 days by river steamer; and correspondence for all districts along the Upper Congo River from Kwamouth as far as Lowa (but not for districts such as Katanga) should save up to a maximum of 11 days in time of transmission by the use of the air service.

Letter packets of all classes, registered and unregistered, but not parcels or insured packets, are admissible.

Any packet intended for onward transmission by the air service should bear the "Air Mail" label in the top left-hand corner, and be plainly marked by the sender immediately beneath it, "Par avion *viâ* Kinshasa." The packet should not be specially prepaid, but a fee of 3 francs per 20 grammes for air conveyance will be charged to the addressee on delivery.

Packets posted in time for transmission to the Congo by other than a Belgian steamship will probably not benefit by the use of the air service, and should not be marked for transmission by it.

A Boat-House as Memorial

ON November 11 a new boat-house at Shrewsbury School, built as a memorial to Lieut. John Edwin Pugh, R.A.F., was opened, his sister, Miss Winifred Pugh, unveiling the memorial tablet. The Air Force was represented by Maj.-Gen. Sir F. H. Sykes.

"Nordstern" becomes "Mediterranée"

BY decree the name of the surrendered German dirigible "Nordstern" has been appropriately changed by the French to "Mediterranée," having regard to its employment next year on the commercial air service between Marseilles and Algiers.

Aerial Surveying in Australia

IT is reported that an aerial survey of approximately 3,000 miles of country in Central Australia has been completed by Mr. Francis Birtles, who reached Melbourne on October 26.

Nungesser's Flying School

THE famous French "Ace" Nungesser is reported to have opened a flying school at Orly. The school receives a State subsidy, and numerous pupils are said to have already enrolled. On a recent visit to the establishment M. Laurent Eynac, the French Under-Secretary of State for Air, is said to have expressed satisfaction at the manner in which the school is being run.

LONDON TERMINAL AERODROME

Monday Evening, November 14, 1921

THE London-Amsterdam air service closes down for the winter months on the 19th, re-opening on April 1, next, with one service in each direction daily. It is proposed, however, that on May 1, this should be increased to two services each way daily.

I understand that the reason for the decision to discontinue flying for the winter is to be found in the scarcity of freight from Amsterdam to London. The loads from London to Holland are not at all bad, and if those in the reverse direction were only as good it would probably be worth while continuing to run through the winter. The Dutch Government have refused to grant a higher subsidy for the winter months, and the K.L.M. have, therefore, decided to cease flying during the winter, rather than continue to run at an appreciable loss.

The question of obtaining satisfactory loads from Holland has always been the " fly in the ointment " with this London-Amsterdam service. It was, for instance, this particular fact, more than any other, which influenced the new Continental Air Lines in deciding to open their career as an aeroplane transport company with a service to Brussels rather than to Amsterdam.

Aeroplane Fitted with Late Fee Letter-Box

MR. HINCHCLIFFE has recently taken an exhibition Fokker F III from Amsterdam to Paris for the Aero Show, and tells me that it is fitted with an emergency exit through the plane. It is, of course, all nickel-plated in the approved style of exhibition machines, and is even complete with a letter-box for the late posting of air mails.

While testing an F II recently, Mr. Hinchcliffe climbed it to a height of 16,000 ft. in one hour with the equivalent of eight passengers on board. This was the identical machine which visited Croydon and Cricklewood last year.

Loads consigned by air continue to fluctuate greatly, but on the whole they are about what could be expected for the time of the year, always remembering the trade " slump," and the improvved facilities now offered by the rail-and-boat services to Paris. Handley Page Transport do not appear to be affected perceptibly by any fluctuations in traffic. The name " Handley Page " is such a household word that a number of people seem to think of an aeroplane and a " Handley Page " as meaning the same thing. The machines of this service are, in consequence, always comfortably full.

Strange Experience with an " Air Express "

MR. MACINTOSH had an uncomfortable experience on Tuesday while piloting an o-400 from Paris. No aeroplanes had left Croydon, owing to fog over the aerodrome: and Mr. MacIntosh, not having met any machines on his way from Paris, was beginning to wonder just how bad the fog at Croydon was. As he approached Lympne, therefore, he decided to fly low to read the ground signals telling of conditions at Croydon. Everything appeared " O.K.," so he put both his engines full on to climb higher on his journey to Croydon. Suddenly there was a noise like the humming of a big shell, and the machine swung round abruptly. A portion of the gears, together with the propeller, had fallen off one of the engines, and it was only with the greatest difficulty that he was able to get the machine safely to the ground. The undercarriage was, in fact, damaged in alighting.

The W. 8 went to Paris this morning, and her pilot has evidently not got out of the habit of taxying to the limit of the aerodrome before taking-off, as is advisable with the o-400's. He " taxied " to the extreme corner of the 'drome, but was off the ground within a few yards. By the time he had reached the edge of the aerodrome he was, in fact, about 700 ft. up!

Airway Staffs in Uniform

IT is rumoured that the various British air lines are about to put their entire staffs into uniform. The Instone staff are, indeed, supposed to be measured for theirs this afternoon. Mr. Alfred Instone was at the aerodrome early this morning, but whether in connection with this vital matter or not is at present uncertain.

Major-General Sir Sefton Brancker travelled to Paris in the " Goliath " today, and several other people prominent in the air world went over by air to the conference which is being held in connection with the Paris Aero Show.

A " Goliath " equipped for night-flying is expected to visit the aerodrome on some dark night this week about midnight in order to test the feasibility of flying from Paris to Croydon after dark. Many machines now land here after dark, though they are not fitted for night-flying, and have neither navigation lights nor illuminated compasses: so that it should be an easy matter for a properly-equipped machine to accomplish the entire journey in darkness.

The Disposal Company are busy on another batch of machines for Brussels, and several of them went over today.

THE LONDON-CONTINENTAL SERVICES

FLIGHTS BETWEEN NOVEMBER 6 AND NOVEMBER 12, INCLUSIVE

Route‡	No. of flights*	No. of passengers	No. of flights carrying Mails	No. of flights carrying Goods	No. of journeys completed†	Average flying time	Fastest time made by	Type and (in brackets) Number of each type flying
						h. m.		
Croydon-Paris	25	34	5	19	23	2 40	D.H.18 G-EARO (1h. 55m.) ...	B. (6), D.H.18 (1), G. (4), H.P. (4), Sp. (4), V. (1).
Paris-Croydon	27	63	11	26	19	3 15	Spad F-ACMG (2h. 35m.) ...	B. (4), D.H. 18 (2), G. (5) H.P. (3) Sp. (4), V. (1).
Croydon-Amsterdam ...	5	2	5	5	4	3 19	D.H.9 H-NABE (2h. 32m.)	D.H.9 (2), F. (2).
Amsterdam-Croydon ...	4	3	3	4	3	3 12	D.H.9 H-NABO (2h. 20m.)	D.H.9 (2), F (1)
Totals for week ...	61	102	24	54	49			

* Not including " private " flights. † Including certain journeys when stops were made *en route*.

‡ Including certain diverted journeys.

Av. = Avro. B. = Breguet. Br. = Bristol. Bt. = B.A.T. D.H.4 = De Havilland 4, D.H.9 (etc.).
F. = Fokker. Fa. = Farman F.50. G. = Goliath Farman. H.P. = Handley Page. M. = Martinsyde. N. = Nieuport.
P. = Potez. R. = Rumpler. Sa. = Saimson. Se. = S.E. 5. Sp. = Spad. V. = Vickers Vimy. W. = Westland.

The following is a list of firms running services between London and Paris, Brussels, etc., etc.:—Co. des Grandes Expresses Aériennes; Handley Page Transport, Ltd.; Instone Air Line; Koninklijkie Luchtvaart Maatschappij; Messageries Aériennes; Syndicat National pour l'Étude des Transports Aériens; Co. Transaérienne.

France's New Air Lighthouse

FROM France it is reported that the French Air Ministry has recently acquired a new aerial lighthouse, which is said to eclipse entirely anything that has hitherto been attempted in the way of lighting up the air routes. The new lighthouse, which, it is stated, is to be erected on Mount Africa near Dijon, at an altitude of 1,500 ft. above sea level, is said to be of 1,000,000,000 candle power, and, according to *The Times*, it is expected that in clear weather it will be visible for a distance of 200 miles. The aeroplane would, however, have to be at an altitude rarely reached by commercial aeroplanes to see the light at that distance.

FLIGHT

AUXILIARY AIDS TO THE AIR FORCE

AN important address, which we propose dealing with Editorially next week, was given by Air-Marshal Sir H. M. Trenchard to the Scottish Branch of the Royal Aeronautical Society at Glasgow on November 14, when Lord Weir presided. During his remarks the Chief of the Air Staff said :—

I must begin by calling attention to the difference between the Air Service and the two older Services. My orders when I became Chief of the Air Staff were to *build up* an Air Force. That is plainly a very different thing to maintaining an already existing and long-established Service.

Though I am the representative of the Air Service and of the Service side of aviation, I do not want it to be thought that I am in any way out of sympathy with civil aviation. I am not. But naturally I have to look at the question from the Service side and from the point of view of the defence of the Empire and the most economical way of conducting it. The principle that guides me is what is the most economical method of carrying out the "insurance" of the Empire; that means what is the least cost at which the Empire can be adequately defended.

All probably know the history of the R.A.F.: how the Air Service started in 1912 in the form of a Naval and a Military wing; how these parted company almost at once, and on the outbreak of War developed into the R.F.C. and R.N.A.S., completely separate organisations with no connection as regards enlistment and training of personnel, supply of material or design and research; how each expanded and how competition between them led to waste of money and loss of efficiency.

After many compromises, none of which were wholly successful, the plunge was eventually taken and the R.A.F. was created as a separate service in April, 1918, amalgamating the R.N.A.S. and R.F.C. At the Armistice the force numbered some 40,000 *officers and cadets and* 300,000 *other ranks*, and the last three years have been spent in reducing the force to a size more in accordance with post-War finance and reorganising it to meet the essential needs of the moment while retaining the capacity for future expansion.

Briefly, the force today consists of the minimum number of squadrons required to meet Imperial needs overseas, with a handful of squadrons in the United Kingdom sufficient to provide some measure of co-operation with the Navy and Army and an almost negligible reserve. I say that the R.A.F. consists of this because this is the fighting strength, and therefore all that counts when measured against commitments. Behind this fighting force there are, of course, training establishments, depôts and research establishments.

Apart from the few squadrons at home and the units co-operating with the Navy, the R.A.F. is employed at present in five only of our overseas possessions or protectorates, namely, India, Egypt, Palestine, Aden and Mesopotamia, or, to give it its new official name, "Iraq." The problems which confront the Home Government and the local Governments in these countries are the maintenance of internal order and the prevention of external aggression. The rôle of the R.A.F. is not confined, as a great many people seem to imagine, merely to assisting military forces maintained at their former strength. It is becoming plainer every day that the R.A.F. can do much more than this, and can perform equally or more efficiently some of the work hitherto entrusted to the Army and Navy, at a greatly reduced cost, thereby lightening the burden on Imperial and local exchequers. The extent to which this can be done depends, of course, on local conditions. This fact has lately received official recognition in the decision to hand over to the R.A.F. the responsibilities hitherto borne by the *Army in Iraq* as from October 1 next, thereby securing a saving of many millions.

The course adopted in the case of Mesopotamia is, I am convinced, certain to be more widely adopted in future as the principles governing the correct employment of R.A.F. come to be more generally recognised. The value of the R.A.F. in policing our overseas possessions lies, not only in its capacity to strike at once and at a great distance, but also in its power to keep up the pressure day in and day out for long periods without retaliation or giving the enemy a chance to loot. A great, if not the main inducement to the frontier tribes in India to give trouble is the chance of obtaining valuable loot in the shape of rifles and ammunition. Added to this is the fact that they are warlike people and take an innate pleasure in fighting for its own sake. Neither inducement exists when their enemy acts entirely from the air.

Similarly, it has sometimes been said that our material effect is not nearly so great as that of columns of infantry advancing and shooting at opposing numbers. This is true. But if one of our columns goes out to find a truculent tribe, and inflicts, say, 500 casualties on the enemy, probably our column suffers 300 casualties. But again, it is a very different pair of shoes if the enemy suffers, say, 100 casualties and can inflict none: therefore I say that action from the air is humane and is economical. I am very strongly of the opinion that the great advantage of the Air Force is that in these small wars it offers to the enemy no "ground bait" in the shape of guns and rifles to fight for.

One of the principles on which we have therefore always insisted—and I think its correctness is being more and more widely accepted—is that the Air Force in such countries should be employed in a primary capacity and not in combination with ground troops, which not only restrict its freedom of action, but also offer the enemy the very inducements for which he goes to war.

Apart from the policing of native countries, the rôle of the R.A.F. is bound to be enlarged in future in many other directions.

With regard to the sea, in addition to what it will, of course, have to do in the way of spotting for the guns of the fleet and in reconnaissance, in my opinion the possibilities of the air at sea are as great, and in some ways greater, than on land. A comparison between the modern coast-defence gun and aircraft is interesting in this connection.

A 15-in. naval gun has a life of only 80-100 rounds, after which it wants either re-tubing or the range table altered. The bursting charge of its projectile is but 45 lbs. of high explosive. Existing aeroplanes can carry a bomb containing 1,600 lbs. of explosive, and their carrying capabilities will be greatly increased in the near future. The extreme range of a 15-in. naval gun is 21 miles, while that of existing aeroplanes is at least 200 miles at a conservative estimate, and this too will be much greater before long.

Finally we come to the defence of the British Empire from air attack, and in that, of course, the question of the defence of the British Isles from air attack will undoubtedly become one of our responsibilities. Though we are confident that no great war can take place for some time, I am in my position compelled to contemplate that event as a possibility. This leads to the question: How is the air defence of these islands to be carried out without great permanent Air Service units, and how can civil aviation help to this end?

Many reports have been issued upon civil aviation. Subsidies have been discussed. Hundreds of letters on the subject have appeared in the Press. But I cannot help noticing that in many of them the statement has been made, and it has been taken for granted without definite proof, that civil aviation is vital to the Service. My belief is that if civil aviation can be made to pay in any other country, then it will become vital to the Service in this country: and if it can be made to pay in a large way in this country, even though it cannot in others, then it will become a factor that will establish the predominance of our air supremacy for all time. If, on the other hand, the taxpayer has to find the money to keep civil aviation going, then in my position I must ask how much money he has to find, and could I for the same sum of money promote and maintain a scheme of insurance for the Empire? And if I find that the subsidy would give me perhaps *only* 40 *or* 50 *extra machines, or even* 100, *and* 40 *or* 50 *or even* 100 *pilots*, and that for the same sum I could get the equivalent of five or six squadrons and parks on the ground, then (ignoring for a moment the usefulness of closer communication) I would certainly say that we must have the squadrons, because the wastage in a war like the last War (and as it will be in the next war) is from 800 to 900 per cent. per annum in machines, and a very large number of lives. In fact, 40 or 50 machines, perhaps, would be a three months' wastage in only one squadron.

And how could we get these squadrons? Surely by some system of an *auxiliary Air Force*, a citizen force like the Territorials, but not necessarily on the Territorial basis altogether, having only short periods of training each year once the pilots had been taught to fly. In my opinion it would take some years to make this force, but I consider it could be done and that it would become an efficient force: and provided it became sufficiently efficient, it would, of course, be much more economical than a defence system of permanent service squadrons.

This again would be the means of spreading the knowledge of the air among our great civilian population, and would strengthen the general desire for air travel. In other words, the Service would lead, and the trade would follow the flag.

There is in the Air Force a short service scheme for officers.

This is working well, and a large number of the right type and stamp are coming forward and asking for Short-Service commissions. *They will be our Reserve*, I hope, in time; but the auxiliary Air Force will be a force for the defence of these shores, though I hope they will accept liability to serve abroad if ever necessary.

I feel, again, that one of the ways in which the Service will help civil aviation in the future will be that wherever there is a group of Service Aerodromes it will be connected up, if possible, with the next nearest group. This is necessary from the point of view of economy, and also to facilitate re-inforcement. It is obvious that if we have a group of aerodromes in Egypt, they should be connected with the next group in Palestine, and Palestine again with Mesopotamia, and Mesopotamia with India, and so on. Then when these groups have been connected over the desert places and the routes have been made, and when it has been shown that the weather and general conditions are suitable for flying for Service machines, and for training and general Service purposes, and when for Service purposes machines are flying on occasion from one group to another regularly, I hope that civil firms will come forward and say "Why should we not fly from this country to that country and carry goods and passengers to the farthest corner of the British Empire?" It would be possible then to do it economically from a civil point of view, for it would certainly relieve civil aviation of the cost of planning and marking the routes in the initial stages, and even making aerodromes; and civil aviation would perhaps be enabled really to pay in this way.

I would like to point out the number of days that are saved in carrying mail from Baghdad to Cairo, and *vice versa*. This mail carrying has not been a special service, but has been done in the ordinary course of Service training of pilots, and with the supply of machines and spares and other service work connected with the air, and it has been going on regularly for the past three months over the waterless and trackless desert.

(Sir Hugh then gave figures showing days saved from three to twenty-four between London and Baghdad, the average saving between Cairo and Baghdad being thirteen days.)

Continuing he said:

Surely this is better than trying to make an experimental route with the great expense of opening and making special aerodromes and doing a great flight over a certain line of country and then doing nothing more. It is impossible in view of the expense of properly marking out a route and of keeping wireless communication going for nothing but a civil flight in the initial stages, to make it ever pay, and the money is simply thrown away except for the fact that it is proved once more, if further proof were needed, that given the necessary facilities machines can fly from one point to another anywhere in the world.

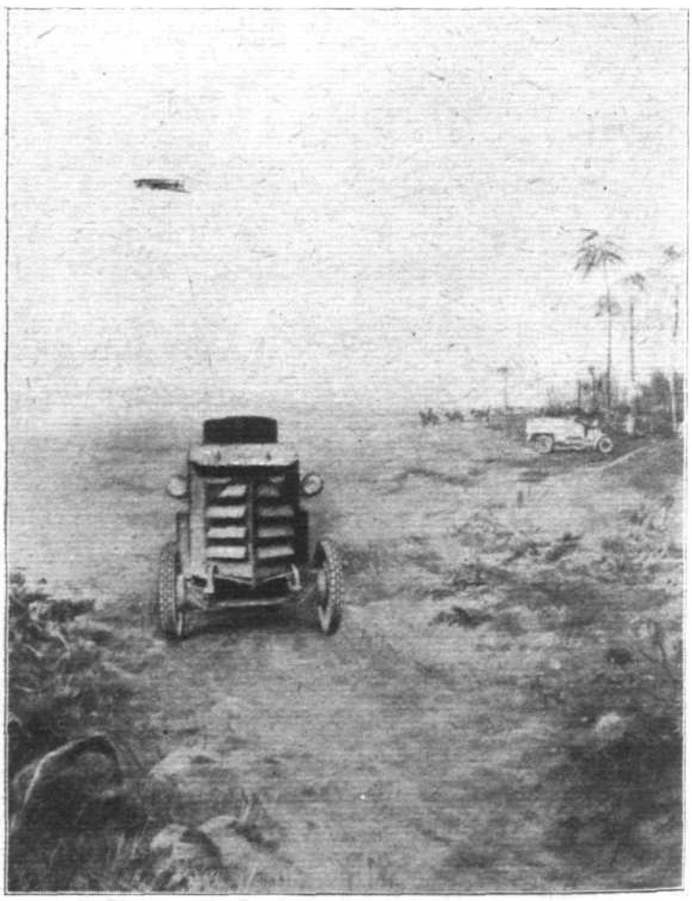
There is another point that I want to touch on. I understand that some of you have asked in other places for an officer's training corps, in which officers can fly. Now what that really means is joy-riding at the Government's expense, and unless it is really necessary from a Service point of view, I will not recommend that we should pay the money for you to get it. It is asked for really by the ex-pilots who want to fly. I sympathise with them and admire them for wanting to go on flying, but as we do not expect a war, I do not know that it would be of much advantage. What I have to think of is how the coming generation is going to be taught to fly, which is much harder and more expensive. I admit that to let the ex-pilots fly would be comparatively cheaper, but in these days when, as we thoroughly recognise, economy is so necessary, it would be false economy to keep in practice a number of pilots who will be too old in ten or fifteen years' time.

I understand that you are interested locally to know whether you are going to have Auxiliary Air Force squadrons here. Well, when the time comes when it will be necessary to pay for that form of insurance, I assure you that we have Glasgow marked down as one of the places in the vicinity of which it will be necessary to have a squadron. In this connection I have seen the correspondence on the subject of the Renfrew Aerodrome; you have asked why Glasgow University should not have the same facilities as Cambridge. Well Cambridge came forward and offered a chair of Aeronautics, and I had to find aerodromes in suitable places where the buildings were good and where it would be economical for us to remain; the two conditions coincided, and I was able to place the aerodrome in the vicinity of Cambridge for Service purposes. In the case of Glasgow, it is not at present possible.

I am not asking for it now, nor, in view of the need for economy, is it possible to do the same here, though I had hoped that the local authorities here might have found it possible to rent a ground and build a few sheds. But we hope that if the auxiliary Air Force comes into being the local associations will be able to find the ground for their aerodromes and have them formed in their own neighbourhoods. Some assistance may be needed from the Government, but I am not empowered to say how much (if any) help will be given.

In regard to research work on aviation.

You know that our Research Department at the Air Ministry is continually at work trying to find improvements. It is the intention and policy of the Secretary of State for Air to put in control of it the best Service man or civilian that can be found to accept the appointment and carry forward this important work. But what we want is this: You or others have suggested various points that you would like at different times, and I am afraid I am not giving you much of what you ask for; therefore, I am going to ask you for something in return! You are great engineers, and we want improvement in aero-dynamic efficiency. There has not been above 4 per cent. of improvement in this direction in the past four years in heavier-than-air machines. There have been improvements in reliability and everything else, but in actual aero-dynamic efficiency there has been little or no progress. If we want greater speed, we have to make some sacrifice in some other direction, for example; either in range or ceiling or something else. To drag through the air a given load at a given speed takes approximately the same horse-power now as it did four years ago. Now you are the very people who are capable of improving things, and I hope you will do it. Give me this in return for what I am not giving you!



"THE SHIP OF THE DESERT"—NEW VERSION: An armoured car, reconnoitring under the direction of an aeroplane, in the Mesopotamian desert. This picture is in the collection of Mr. Lionel Rapson, at Ottershaw Park, whither it was forwarded recently by an R.A.S.C. corporal who was on the inventor's staff in France, Belgium and (late) German S.W. Africa, during the War. Air-Commodore Brooke-Popham has recently spoken very appreciatively of the success of one of Mr. Rapson's inventions in the Mesopotamian operations, during which camel-thorn and other cacti have played "Old Harry" with ordinary pneumatic tyres, while leaving those on the British armoured cars unscathed.

FLIGHT

ROYAL AIR FORCE MEMORIAL FUND

AT a meeting of the Executive Committee of the Royal Air Force Memorial Fund held on November 9 at 7, Iddesleigh House, Caxton Street, S.W. 1, the following Members of the Committee were present:—Lord Hugh Cecil (in the Chair), Dame Helen Gwynne-Vaughan, Mrs. Barrington-Kennett, Sir Charles McLeod, Air Vice-Marshal Sir John Salmond, Air Vice-Marshal A. V. Vyvyan, Maj.-Gen. Sir Sefton Brancker, Air-Commodore H. R. M. Brooke-Popham, Mr. F. E. Rosher, Mr. H. E. Perrin and Mr. W. S. Field.

A list of donations and subscriptions received since the last meeting on October 10 amounting to £3,522 18*s.* 1*d.* was submitted, and while the total appears a very satisfactory one, the Committee were concerned to think that it was chiefly composed of large donations from the Air Force Pageant held at Cairo in March, 1921, and one or two other sources, and it is regretted that the general public are subscribing, at the present time, very little to this deserving Fund. It is, of course, fully recognised that times are exceedingly bad, but it is earnestly hoped that the fountain of public generosity will soon begin to flow again.

The list of Grants made since the previous meeting on October 10 was also read out to the meeting, and amounted to the considerable sum of £428 2*s.* 5*d.*

It is hoped, given favourable conditions, that it may be found possible to unveil the War Memorial on August 4, 1922, the date of the outbreak of the Great War in 1914.

On the recommendation of Air Vice-Marshal A. V. Vyvyan, A.O.C., Coastal Area, the Committee, as a special case, sanctioned a contribution of £5 towards the Memorial being erected in Hull Cemetery to the Crew of H.M. Airship "R.38."

The Committee sanctioned a recommendation of the Propaganda Sub-committee for an advertisement showing the objects of the Fund and the necessity for subscriptions, which it is intended to have displayed (with the consent of the Navy, Army and Air Force Institutes Council) in all R.A.F. canteens throughout the United Kingdom. It is hoped, by this means, to draw the attention of the serving members of the R.A.F. to the needs of this Fund and the necessity of their assistance.

CAPTAIN GUEST AT THE LORD MAYOR'S BANQUET

IT is usually accepted that the Lord Mayor's Banquet on November 9 gives annually a chance for the Prime Minister to set forth his views upon any immediately pressing public problem when Parliament is not sitting, in terms which perhaps he might be shy of using in Parliament. If all other Ministers' enunciations are to be regarded in an equally responsible light, there is a promise of aviation widening out presently if the response of Capt. Guest, the Secretary of State for Air, has any meaning beyond empty verbiage. Capt. Guest, in replying for "The Imperial Forces" on behalf of the Air Ministry, said:—

"It is now three years since the Royal Air Force has had a Secretary of State to reply for it, and I trust that it is significant that one has appeared upon the scene again. This service was forged in the crucible of war, and is steadily developing and building a casket in which are deposited the secrets which we paid so heavy a toll in precious lives to obtain.

"Man began to scratch at the earth innumerable centuries ago, and still can only run! He then build himself a boat, and still pushes it laboriously through the sea! In all these centuries has he advanced, either in conception or in effect, one-thousandth part so fast or so far as those who navigate the air have done in the last ten years?

"This development has already revolutionised both thought and security. England is no more an island. I am told, but I can hardly believe it, that there are some people either so ignorant or so prejudiced that they wilfully blind themselves to the fact that the air is as much a separate element as the sea is from the land, and deny both the rapidity of aerodynamical development in the last few years and its amazing future possibilities.

"The secrets of both land and sea can now be exposed and recorded on the deadly photographic film. No landsman or sailor can follow or divine the intentions of the mechanical bird, any more than the sheep can those of the seagull which rises and disappears from its side. From sunrise to sunset it can cover a thousand miles today with ease—Cairo to Baghdad. There is no knowing on what mission its flights may be launched—the postbags of peace or the bombs of war.

"Flying so inevitably develops a peculiar and distinctive psychology that only those who have lived and thought and fought in the air possess the necessary understanding, sympathy and knowledge to direct and control the flights and performances of such men. This may sound extravagant, but it is not so—it is a cold statement of fact: moreover, it is a path to economy. The nation groans under increasing responsibilities and depleted resources. Since 1914 the frontiers of the Empire have been extended, but the number of our garrisons has remained the same. The balance of security must be made good. How? Man must more and more harness art and science to his service, and thereby increase his individual effectiveness tenfold. I submit that economy and the development of this new mechanical power go hand in hand.

"This revolution in transport is equally important on the civil side. Commercial flying, so far, is neither very popular nor profitable, but profound faith in its future remains, though the development be slow. On both sides of aviation we must press forward or be left behind, and there can be no advance or security for our scattered Empire if it does not utilise to the full the unmeasured facilities offered by a new service in a new element which we are learning to control."

73rd WING R.A.F. ANNUAL DINNER

ON the night of October 29, many commissioned members of the late 73rd Wing R.A.F. (perhaps better known as "Yarmouth Seaplane and Sub-Stations") gathered together at Oddenino's to talk and dine, this being the second time that such a gathering has been held.

To an intelligent observer, such gatherings are full of interest, largely because all the members wear an air of respectability which seems strangely out of keeping with their War-time character, moreover when one has called one's messmates all sorts of nick-names and treated them with scant respect, it is somewhat hard to really realise that in civilian life they may be highly influential and respected citizens.

The Chairman on this occasion was Lieut.-Col. Nicholl, D.S.O., D.S.C., and as he, more than anyone else made Yarmouth the premier Seaplane Station in the world (this is one's firm belief) no better choice could have been made.

The usual speeches were made and toasts given; three were especially of merit, that of Maj. Galpin, who talked about the glorious history of the Station; that of Squad.-Leader Gaskell, who replied with his usual grace to the toast of the Royal Air Force, and finally that of a well-known late Sub, now Flying Officer, who with characteristic modesty admitted that not all the best things were done by him in the good old days when war was waged in the neighbourhood of Yarmouth.

The gist of all the speeches was, that during the War the R.N.A.S. was the finest branch of the Services, and that Yarmouth Seaplane Station was the finest unit in that branch—which is all to the good, for, after all, the attitude of "Did the Lord make you *too?*" when applied to the Services, is an excellent one.

The gathering all agreed that the greatest thanks were due to the Secretary and Committee for their untiring efforts in making the occasion such a success, and of course decided to perpetuate the affair.

Amongst the more notorious members of the old station, one noticed Major Cadbury, Squad.-Leader Gaskell, Maj. Galpin, Flight-Lieut. Livock, Capts. Featherstone, Hodson, FitzRandolph, Fane, Bolton, Siddons-Wilson, Bloom, Holman, Flight Officer Potter, Flight Officer Burton, Lieuts. Guard, Barwell, Hands, Allen, Ellis, Gamble and Pole.

Members are reminded that the dinner will be held on the last Saturday in October, 1922. Any information may be obtained from the Secretary, G. F. H. Bloom, L.D.S., 7, Welbeck Street, W. 1, or Major Galpin, Air Ministry.

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the Royal Air Force are notified :—

Wing Commanders.—T. R. Cave-Browne-Cave, C.B.E., from Air Ministry (D.G.S.R.) to command Marine and Armament Experimental Establishment (Coastal Area). 14.11.21. N. J. Gill, C.B.E., M.C., to command R.A.F. Base, Gosport (Coastal Area). 1.10.21.

Squadron Leaders.—R. E. Saul, D.F.C., from School of Army Co-operation (Inland Area) to Iraq Group Headquarters (Middle East Area). 2.11.21. C. C. Durston, from No. 28 Squadron (India) to command R.A.F. School (India). 1.10.21. R. P. Whitehead, from R.A.F. School (India), for duty as Educational Officer, Headquarters, R.A.F. (India). 1.10.21. W. V. Strugnell, M.C., from No. 1 Flying Training School (Inland Area) to R.A.F. Depôt (Inland Area) (Supernumerary Non-effective) on ceasing to be attached to School of Military Administration. 1.11.21. R. B. Maycock, O.B.E. (The posting of this officer from No. 230 Squadron to School of Naval Co-operation and Aerial Navigation, with effect from 7.11.21, is cancelled.)

Flight Lieutenants.—E. P. Hardman, D.F.C., to No. 30 Squadron (Middle East Area), on ceasing to be attached to Central Air Communication Section. 2.10.21. G. M. Moore, M.C., from No. 1 Flying Training School (Inland Area) to Central Air Communication Section (Middle East Area). 2.11.21. J. A. Stone, from the Packing Depôt to R.A.F. Depôt (Inland Area). (Supernumerary non-effective.) On ceasing to be attached to No. 1 Stores Depôt. 25.10.21. J. R. Crolius, M.B., to Research Laboratory and Medical Officers' School of Instruction (Inland Area). On appointment to Short Service Commission. 19.10.21. L. W. Hall, to Liverpool Recruiting Depôt, on completion of duty at Manchester Recruiting Depôt. (Inspectorate of Recruiting, Coastal Area.) 21.11.21.

IN PARLIAMENT

Air-Mail Services

MR. RAPER on November 8 asked the Postmaster-General if, in order to assist British civil aviation, he will take steps to make an issue of aerial postage stamps?

Mr. Kellaway: I am considering how far wider publicity can be given to existing air-mail services with a view to increasing public interest in the traffic; but, as at present advised, I do not think that the issue of a special postage stamp would have the effect desired by the hon. member. A blue air-mail label, to be affixed to air-mail correspondence, is already issued on application at all head and branch post offices. Letters can be posted for the air mail in any letter box and at any time; and it would obviously hamper the free use of the service if only air-mail stamps could be used.

Mr. Raper: Is the right hon. gentleman aware of the fact that already in France they are issuing special aerial postage stamps, and that it has been very helpful to the service?

Mr. Kellaway: I shall be glad to consider that, but I hope my hon. friend will also consider the point I have put.

Wireless Telephony on Passenger Aircraft

MR. RAPER on November 9 asked the Secretary of State for Air whether, in view of the danger to aircraft involved by the frequently sudden arrival of fog over various sections of the London-Paris air route, the Air Ministry will take steps to issue a Regulation making it compulsory for all passenger aircraft to be equipped with wireless telephony?

Captain Guest: I agree as to the importance of wireless telephony or telegraphy in the circumstances stated. The International Convention on Aerial Navigation of 1919 provides (in Article 14) for W/T apparatus being carried by aircraft used in public transport and capable of carrying 10 or more persons "when the methods of employing such apparatus shall have been determined by the International Commission for Air Navigation," a body which will be set up as soon as the Convention itself has been ratified by a majority of the signatory States. When the Convention has been so ratified, it is proposed to issue Regulations making the carrying of W/T by British aircraft compulsory. I may add that it has been meanwhile arranged that all large machines at present employed on the subsidised British Cross-Channel service shall be equipped with W/T apparatus.

Aerodynamics Department of the National Physical Laboratory

MR. RAPER asked the Financial Secretary to the Treasury whether there is any question of closing down the aerodynamic Department of the National Physical Laboratory; and, if so, whether he will reconsider this matter, in view of the services rendered by this Department to the Advisory Committee for Aeronautics and to the aviation industry?

Mr. Young: No specific proposals for the provision of funds for the maintenance of the Aerodynamics Department at the National Physical Laboratory after the close of the current financial year have at present reached the Treasury. Any such proposals in regard to public Estimates for 1922-3 must obviously be considered in view of the general financial position and the need for drastic reductions of public expenditure even in the case of *prima acie* very desirable public services. But I am aware of the importance attached in certain quarters to the work of the Department in question, and the matter will be fully considered before the detailed Estimates of the Departments concerned for the coming financial year are finally determined.

Mr. Raper: Is it not a fact that this Department is the only provision made by the State for the scientific investigation of aerodynamic problems, and is not the cost a minor matter in comparison with the importance of the work which is performed?

Mr. Young: I believe that the suggestion contained in the first part of my hon. friend's question is quite accurate.

Airships

SIR H. BRITTAIN asked the Parliamentary Secretary to the Admiralty if it is proposed to include in next year's Navy Estimates a Vote for the construction, maintenance, and operation of airships?

Commander Eyres-Monsell: The answer is in the negative. Responsibility for airship construction and maintenance rests entirely with the Air Ministry.

Civil Aviation

MR. RAPER, on November 10, asked the Secretary of State for Air if he is aware that at the beginning of last month France had six international air routes in operation; that next year France proposes to create air connections between France and her colonial possessions, communication between Corsica and Tunis being carried out by a seaplane service, and from Marseilles or Toulon to Algiers by airship, as well as aeroplane connections between Oran and Morocco, and between Toulouse and Morocco *via* Spain; and that British aerial transport today, from leading the world in 1919, has dropped behind both France and Germany; and whether he will now make a statement as to what is the definite policy of His Majesty's Government towards aviation, both military and civil?

Captain Guest: I am aware of the activities of French aviation, as stated by my hon. and gallant friend, and it is obvious that the French Government fully realises the importance of aeronautics, both service and civil; but I do not think it is possible, in the form of question and answer, usefully to compare the French, or German, and British positions in this matter. A full statement of the Government's policy in regard to civil aviation has recently been made, and I cannot, at present, add anything to what was then said. If my hon. and gallant friend wants something further and more comprehensive, I must ask him to wait until the Air Estimates are introduced next Session.

Mr. Raper: May I ask my right hon. friend, who, as we all know, has the interests of aviation greatly at heart, whether he will agree to discuss with me the possibility of organising an Imperial Air Service?

Sir H. Brittain: May it not prove very difficult to regain our ascendency in the air if the rumour that the Air Ministry is to be done away with proves correct?

Captain W. Benn: Have any recommendations been made by the Geddes Committee relating to the Air Ministry, and, if so, what are they?

Mr. Speaker: That does not arise out of the question on the Paper.

Mr. Raper: May I have a reply to my question?

Captain Guest: That arises out of the next question on the Paper.

Air Ministry and Royal Air Force

MR. RAPER asked the Prime Minister if His Majesty's Government intends to abolish both the Air Ministry and the Air Force as a separate service?

The Prime Minister: No such decision has been taken by His Majesty's Government.

IMPORTS AND EXPORTS, 1920-1921

AEROPLANES, airships, balloons and parts thereof (not shown separately before 1910). For 1910 and 1911 figures see "FLIGHT" for January 25, 1912; for 1912 and 1913, see "FLIGHT" for January 17, 1914; for 1914, see "FLIGHT" for January 15, 1915; for 1915, see "FLIGHT" for January 13, 1916; for 1916, see "FLIGHT" for January 11, 1917; for 1917, see "FLIGHT" for January 24, 1918; for 1918, see "FLIGHT" for January 16, 1919; for 1919, see "FLIGHT" for January 22, 1920; and for 1920, see "FLIGHT" for January 13, 1921.

	Imports		Exports		Re-Exportation	
	1920.	1921.	1920.	1921.	1920.	1921.
	£	£	£	£	£	£
Jan. ...	2,323	4,459	32,752	87,128	697	2,285
Feb. ...	9,320	2,379	68,932	59,829	—	19
Mar. ...	2,092	14	67,600	118,199	—	1,565
April...	5,918	1,370	148,484	138,983	—	450
May ...	761,425	3,350	237,627	59,624	400	1,818
June ...	491	5,181	300,572	79,713	61,150	—
July ...	51,020	540	286,646	530,628	—	850
August	116	343	130,774	111,595	2,544	—
Sept.	386	620	302,802	145,755	—	—
Oct. ...	445	4,256	106,954	101,567	913	580
	833,536	22,512	1,683,143	1,433,021	65,704	7,577

AERONAUTICAL PATENT SPECIFICATIONS

Abbreviations: cyl. = cylinder; I.C. = internal combustion; m. = motors

The numbers in brackets are those under which the Specifications will be printed and abridged, etc.

APPLIED FOR IN 1920

Published November 17, 1921

13,603. G. J. BUTLER, J. A. VIELLE and E. W. JODREY. Revolving-cylinder engines. (170,317.)

16,462. K. VON MAYRHAUSER. Gyroscopic compasses. (145,432.)

16,580. ANSCHUTZ AND CO. Gyroscopic apparatus for measuring lateral oblique position of aircraft. (145,460.)

19,564. W. D. ODDY and W. J. ADDERLEY. Propellers. (170,342.)

FLIGHT

The Aircraft Engineer and Airships

36, GREAT QUEEN STREET, KINGSWAY, W.C. 2.

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